Hine's Emerald Dragonfly (*Somatochlora hineana* Williamson) Status Surveys in Southeast Minnesota

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U. S. Fish and Wildlife Service
and
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by
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(Cover photo *Somatochlora walshii*)

Introduction

Hine's emerald dragonfly (*Somatochlora hineana* Williamson) is a federally endangered dragonfly that is associated with wetland habitats that may be broadly described as fens, marshes, sedge meadows, wet meadows, or swamps. These are usually associated with shallow dolomite bedrock and neutral to alkaline groundwater seeps, streamlets or sheet flow. In addition, larvae are believed to depend on burrows of the crayfish, *Cambarus diogenes* (U. S. Fish and Wildlife Service 2001).

Hine's emerald surveys were conducted in 1998 at several Minnesota sites (Steffens 1999). Coming in the wake of newly discovered sites in the Upper Peninsula of Michigan (Steffens 1997), those surveys focused primarily on spring fens in the Laurentian Mixed Forest of northern Minnesota because of their similarities to swamp-northern fen habitats at the Michigan sites. Since that time, some 30 new sites have been found in Missouri and a cluster of five new sites have been found since 2007 in the lower Wisconsin River Valley, in Iowa and Richland counties, Wisconsin (Cashatt 2010). These new Wisconsin sites are only about 40 miles from the Minnesota border. These developments prompted a closer look at the potential for *S. hineana* in Minnesota, especially that portion of the Eastern Broadleaf Forest (Figure 1) south and east of the Minnesota River valley, where there is an abundance of carbonate bedrock (Figure 2).

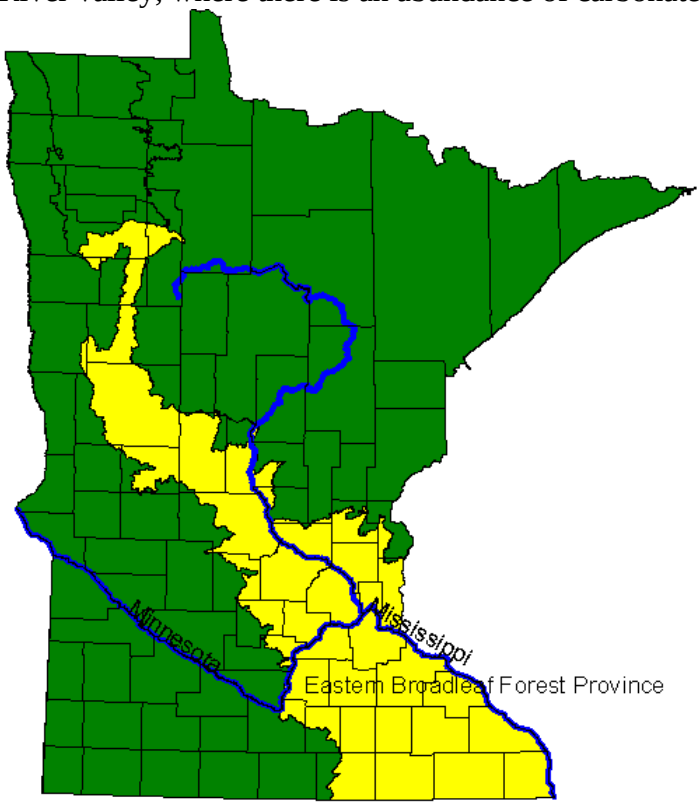

Figure 1. Eastern Broadleaf Province in Minnesota

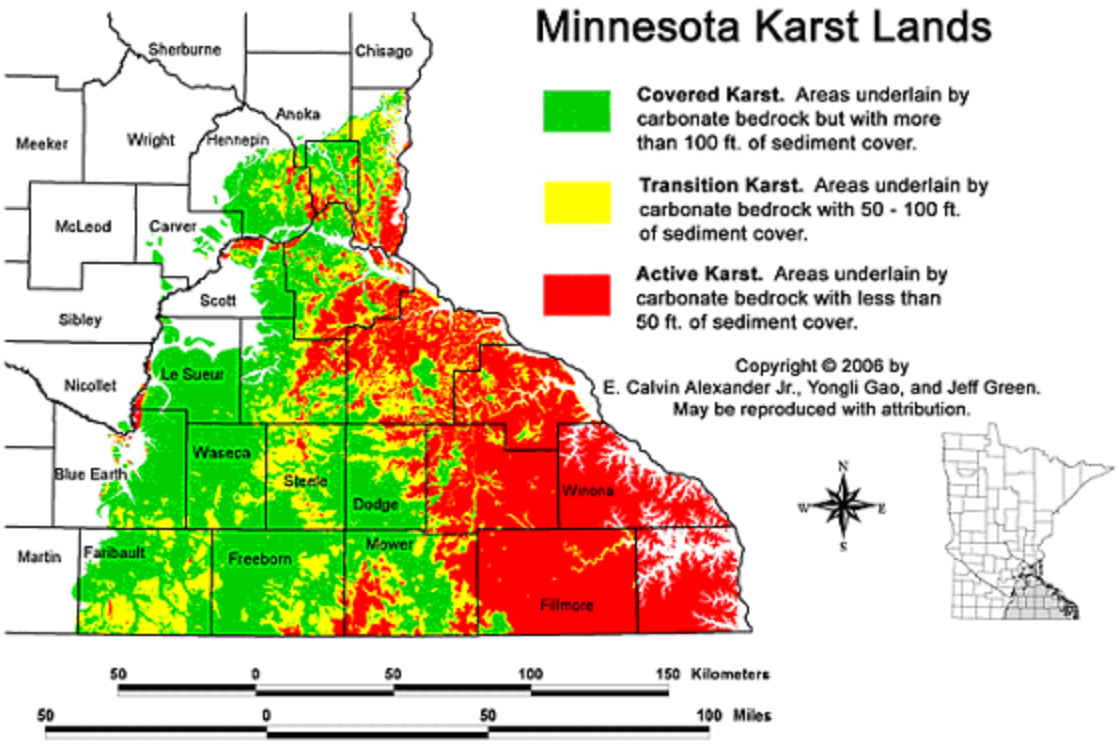

Figure 2. Distribution of carbonate karst in SE Minnesota.

Oneota dolomite of the lower Ordovician Period is the bedrock over large areas of SE Minnesota (MN) (Ojakangas 2009), and caps many of the Mississippi River bluffs. It follows the Mississippi River nearly from Red Wing all the way to the southeastern tip of the state, and it surfaces along the Minnesota river in Le Sueur County. Oneota dolomite is also one of the carbonate rocks near the newly discovered Hine's emerald sites in Iowa County, Wisconsin; it is the caprock on many Lower Wisconsin River valley bluffs (Schultz, 1986).

Minnesota was once home to many dozens or perhaps hundreds of calcareous fens, some of which still occur in SE MN. Calcareous fens may form where groundwater passes through calcareous till or bedrock and then emerges, often at the base of uplands on river valley terraces (Figure 3). This seepage forms distinct wetlands, some with characteristics of potential Hine's emerald habitat. Other seepage habitats that may not qualify as "calcareous fens" (a very specific category with legal protection in Minnesota) for various reasons (absence of *Carex sterilis*, for example) but have circumneutral groundwater seeps, may be found in the same settings.

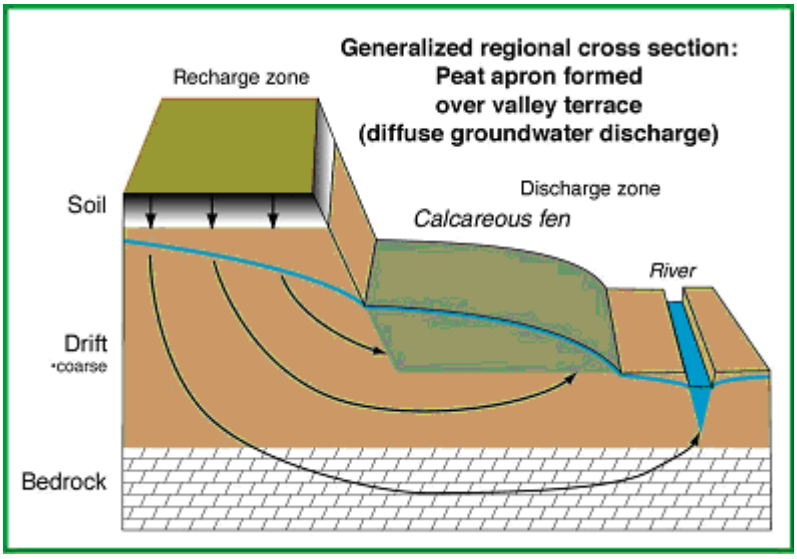

Figure 3. Calcareous fen cross section. (Illustration by James Almendinger)

The most recent information on crayfish distribution in Minnesota is twenty years old (Helgen 1990). Helgen mapped the known occurrences for *C. diogenes* (Figure 4), showing widely scattered locations in northern MN, central MN, and at the SE and SW edges of the Eastern Broadleaf Province. These sites basically surround the current study area, so it was hoped that the species occurs throughout.

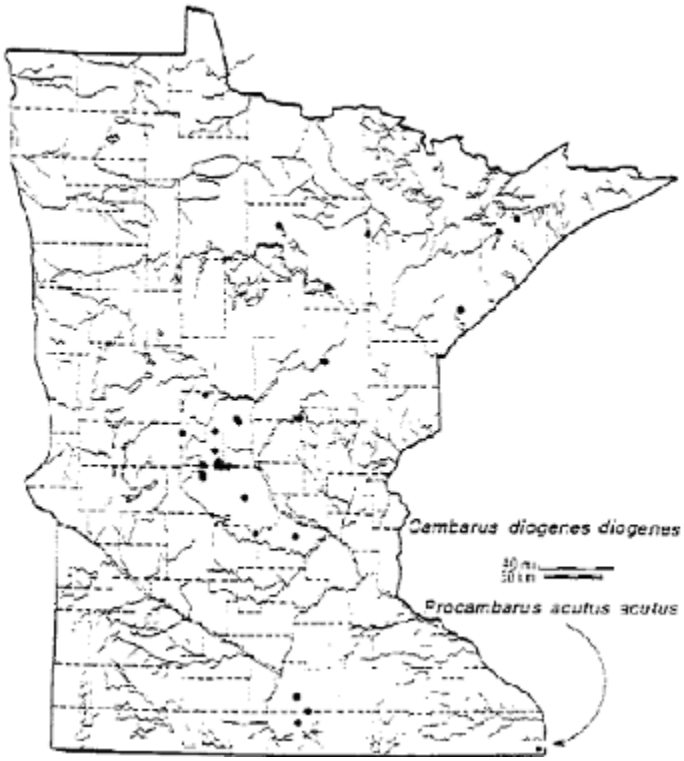

Figure 4. Distribution of *Cambarus diogenes* in Minnesota as of 1990. *Cambarus diogenes* also occurs at the sole *P. acutus* site (from Helgen 1990)

Methods and Materials

Potential habitats in the SE were identified using Minnesota Department of Natural Resources (DNR) karst maps and DNR GIS karst feature layers, printed Minnesota County Biological Survey (MCBS) Maps and Plant Community GIS data (http://deli.dnr.state.mn.us/), USGS 1: 24,000 topographic maps, aerial photographs, the November 2009 MN DNR Calcareous Fen List, information on crayfish distribution (Helgen 1990), and consultation with MNDNR ecologists. Two visits (early May and mid-July) were made to the Hine's emerald locations in the lower Wisconsin River area with recovery team member and Wisconsin Department of Natural Resources Zoologist Bill Smith, to get an idea of what suitable habitat *might* look like in Minnesota.

The Eastern Broadleaf Province of southeastern Minnesota seemed the most profitable place to focus the search, because of its carbonate bedrock and known springs and seeps. After reviewing plant community maps, GIS layers, and community type descriptions, several habitat types emerged as the most promising: calcareous seepage fens, seepage meadow/carr, wet meadow/carr and, in some cases, sedge meadows, which are a subtype of seepage meadow/carr or wet meadow/carr. This amounted to a hundred or more potential sites in SE MN, so this selection was refined further by prioritizing sites a) on large river terraces, like the Wisconsin River sites, b) in less disturbed surroundings, subjectively determined by looking at quantity and continuity of adjacent forest land on aerial photography, c) in consultation with the DNR ecologists and other knowledgeable persons, d) with the knowledge that, while once extensive and pristine, most of the river terrace calcareous fens in the Twin Cities area are degraded and therefore lower priority, and e) wetlands adjacent to uplands are likely to have a hydraulic head and greater likelihood of seeps.

National Wetlands Inventory maps were looked at in a couple areas, but it became apparent that these were a coarser filter than querying MCBS Community Types for the habitats mentioned above. NWI data may be useful later for expanding the scope of habitat searches; the more immediate need was to narrow down the already large number of potential seepage wetland sites to a few dozen high quality ones that could be surveyed in a season.

A preliminary list of potential sites in 12 counties was created (Steffens 2010) and eventually whittled down even further using the above procedures. The selected sites were evaluated in person during surveys; high quality sites with most Hine's emerald habitat characteristics received more survey time and sites lacking in one or more characteristics received less.

Surveys were conducted by walking through suitable habitats, starting off with a random meander and then focusing on better microhabitats within each wetland. The first Hine's emerald adults of the season were seen flying June 16 near Avoca, WI so surveys were started in MN on June 21, 2010 and ended July 21, 2010. Surveys were conducted between 0900 and 2030 hrs, with morning hours spent searching for patrolling males over the wetlands. Afternoons and evenings were split between the wetlands searching for

adults and, later in the day, surveys usually shifted to adjacent roads/trails for feeding individuals or swarms. Temperatures ranged from 70-90 degrees Fahrenheit and, unless otherwise noted, winds were less than 10 mph. An effort was made to conduct as many of the surveys as possible under low cloud cover (<20%).

The presence or absence and character of groundwater seeps, springs, channels, streamlets and the presence of crayfish or crayfish sign such as chimneys and burrows were noted at each site. Crayfish chimneys were easy to observe at some sites; sometimes a manual search was made for burrows by feeling the substrate under the water surface. At a couple sites a handheld dip net was used to seine for larvae.

Observations were made of other dragonflies at survey sites, with an eye toward species known to be Hine's emerald associates in other states (USFWS 2001; see Appendix). Dragonflies were identified at a distance when possible, or netted with a handheld net, identified in hand and released, or were photographed and identified later. Many but not all dragonflies were identified at survey sites; effort was made to avoid diverting time and attention from the the project's focus on *S. hineana*, which would likely occur in very low numbers at the edge of its range. Some of the few *Somatochlora sp.* sightings were very brief and could otherwise have been missed.

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Some of the more common and easily identified plants were noted at each site, with an emphasis on a small number of easily identified taxa that were evident during the May tour of the Wisconsin River *hineana* sites. These are not intended to be taken as calcareous indicators (in fact most SE MN fens lack such indicators, see below), they are mentioned simply for rough comparison to the Wisconsin River sites.

Property ownership was determined using county GIS web sites. Unless noted otherwise in the site descriptions, verbal permission was received to survey all private sites.

Results and Discussion

Three habitat types emerged as having the greatest potential for *S. hineana* in SE MN: calcareous fen, southern seepage meadow/carr, northern wet meadow/carr. These were prioritized because all are fen or seepage meadow habitats influenced by neutral or alkaline groundwater in the pH range 6.0-8.0, which is similar to the range at Illinois sites (USFWS 2001). They are frequently found in the settings illustrated above (Figure 3). A more complete description of these habitat types follows, abbreviated and adapted from MN DNR (2005).

Southern seepage meadow/carr.

Graminoid cover is interrupted to continuous (50–100%); typically dominated by tussock sedge (*Carex stricta*) or aquatic sedge (*C. aquatilis*) with bluejoint (*Calamagrostis canadensis*), lake sedge (*C. lacustris*), prairie sedge (*C. prairea*), woolly sedge (*C. pellita*), and fowl manna grass (Glyceria striata)common. Hairy-fruited sedge (Carex trichocarpa) is dominant on some sites.

• **Forb** cover is variable (5–75%); common species include spotted Joe pye weed (*Eupatorium maculatum*), great water water dock (*Rumex orbiculata orbiculatus*), common boneset

(*Eupatorium perfoliatum*), marsh bellflower (*Campanula aparinoides*), red-stemmed aster (*Aster puniceus*), swamp milkweed (*Asclepias incarnata*), northern and cut-leaved bugleweeds (*Lycopus uniflorus* and *L.americanus*), common marsh marigold (*Caltha palustris*), giant sunflower (*Helianthus giganteus*), and touch-me-nots (*Impatiens spp*.)
• **Shrub** cover is variable. Tall shrubs, if present, include red-osier dogwood (Cornus sericea), pussy willow (Salix discolor), slender willow (*S. petiolaris*), and Bebb's willow (*S. bebbiana*).

Landscape Setting & Soils
Southern seepage meadow/carr is typically associated with groundwater seepage areas at bases of river terraces or beach ridges, on gentle slopes, or on bottomlands between steep bluffs. It also can occur in level wetlands dissected by streams and rivers that may be fed by groundwater discharge. Surface water is derived primarily from groundwater sources and has neutral to basic pH, reflecting the surrounding calcareous till and bedrock substrate. Soils range from mineral or muck soil to sapric peat. Organic sediments range from very shallow to greater than 36in (100cm) in depth

Northern Wet Meadow/Carr
Open wetlands dominated by dense cover of broad-leaved graminoids or tall shrubs.
• **Graminoid** layer consists of dense stands of mostly broad-leaved graminoids, including bluejoint *(Calamagrostis canadensis)*, lake sedge *(Carex lacustris)*, tussock sedge *(C.stricta)*, and beaked sedge *(C. utriculata)*.
• **Forb** cover is variable, with tufted loosestrife *(Lysimachia thyrsiflora)*, marsh bellflower *(Campanula aparinoides)*, marsh skullcap *(Scutellaria galericulata)*, and great water dock *(Rumex orbiculatus)* common, and small or three-cleft bedstraw *(Galium tinctorium* or *G. trifidum)*, bulb-bearing water hemlock *(Cicuta bulbifera)*, northern bugleweed *(Lycopus uniflorus)*, linear-leaved, marsh, or downy willow-herb *(Epilobium leptophyllum*, *E. palustre*, or *E. strictum)*, water smartweed *(Polygonum amphibium)*, and northern marsh fern *(Thelypteris palustris)*occasional.
• **Shrub** cover is variable.
Landscape Setting & *Soils* northern wet meadow/carr is subjected to moderate inundation following spring runoff and heavy rains, and periodic drawdowns during summer. Peak water levels are high enough and persistent enough to prevent trees (and often shrubs) from becoming established, although there may be little or no standing water much of the growing season. Soils range from mineral or muck soil to sapric peat. Because surface water is derived from runoff, stream flow, and groundwater sources, it has circumneutral pH (6.0–8.0) and high mineral and nutrient content.

The two classes above may have subtypes such as "sedge meadow" or "tussock sedge subtype" that were not known for most sites, but are mentioned under site descriptions when known.

***Calcareous Fen (Southeastern*)** This is a subtype of the Prairie Rich Fen Class Open graminoid-dominated fens present mostly on side slopes of erosional features and sometimes on terraces within valleys. Most occurrences are small, although larger occurrences have been documented, especially in the Minnesota River valley.*Carex sterilis* is usually present, but other calcareous fen indicators are rare or absent southeast of the Minnesota River valley.

Occurs where there is an uninterrupted, diffuse discharge of mineral-rich groundwater at the ground surface that is not ponded and where surface water inputs (from rainfall and runoff) are minor relative to groundwater input. Such conditions occur where gentle to moderate surface slopes intersect groundwater-bearing layers perched above less permeable layers; they also occur where permeable formations penetrate confining beds that overlie aquifers with above-surface heads.

The groundwater that supplies these fens is alkaline (pH > 6.7) with a high calcium concentration (> 30mg/l) as a result of flowing through calcareous glacial drift or bedrock. The constantly upwelling cold, anoxic water creates ideal conditions for peat formation, provided water emerges as diffuse seepage and not as a concentrated spring flow. Peat

formation over the area of seepage acts as a sponge to further diffuse the movement of the water and retain it longer on site, enhancing peat production. Peat shelves or domes are the frequent result. Conditions at the surface promote the precipitation of calcium carbonate as marl or tufa, which is incorporated into the accumulating peat.

Fortunately, the Minnesota DNR and County Biological Survey has already identified and mapped many of these habitats across SE MN and the rest of the state.

Surveys were conducted at 28 sites in 8 counties (Figure 5); a description of each follows this discussion. Several particularly promising sites in Goodhue, Le Sueur and Winona counties were visited multiple times. Most sites were in landscape settings similar to that illustrated in Figure 3.

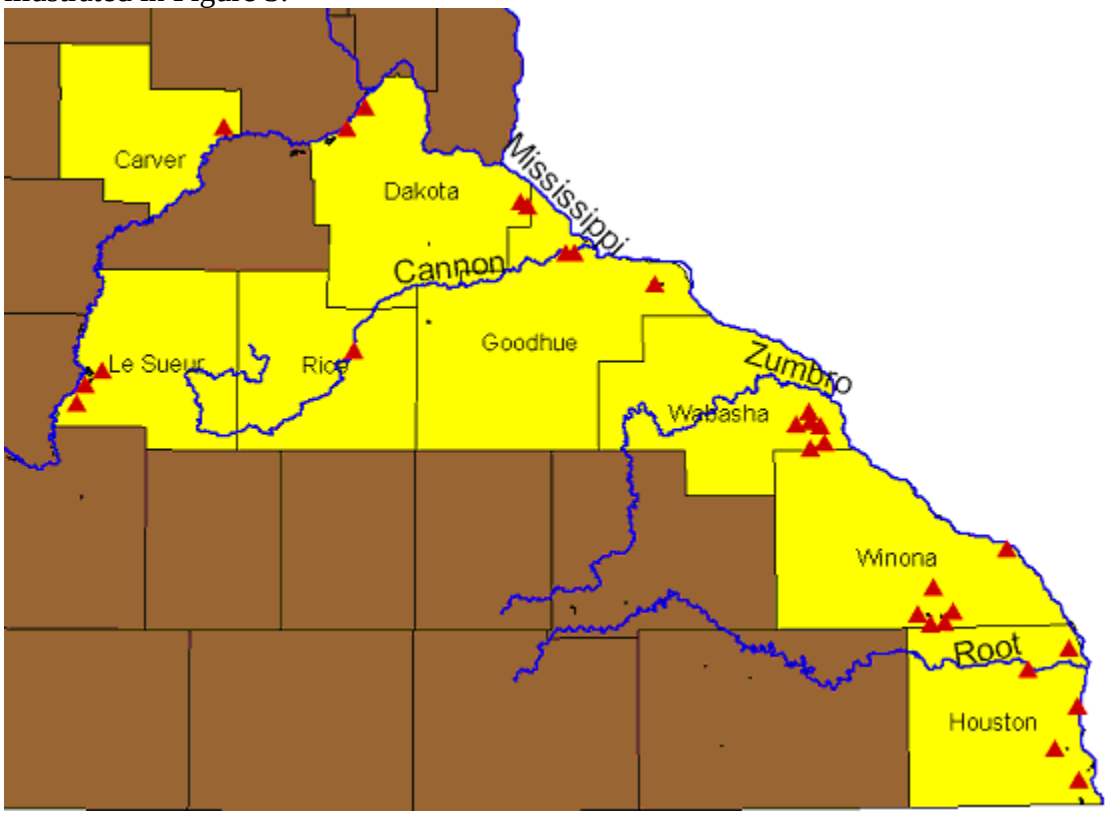

Figure 5. The 28 survey sites in 8 counties (locations approximate).

Hine's emerald dragonflies were not verified at any of the sites, but features of very good potential habitat were found. At several sites unknown *Somatochlora* were seen that may have been *S. hineana*, particularly at the Lamoille seepage meadow in Winona County. Hydrology seemed suitable at many of the sites, although it varied in quality and quantity. Evidence of crayfish (or likelihood of crayfish) – presumably *C. diogenes* – was found at about 75% of the sites.. Hine's emerald associates such as *Somatochlora walshii*, *Sympetrum semicinctum*, and *Amphiagrion saucium* were also found at a few sites. All of the habitat requirements and some associate species were present at a small number of sites. A summary of key results, subjective impression of groundwater suitability and priority recommendations for follow-up are presented in Table 1.

Table 1. Groundwater suitability, known Hines emerald associates (USFWS 2001), crayfish presense absence or likelihood, and suggested priority for follow-ups (see text for additional explanation)

Site	Groundwater	Associates	Crayfish	Priority
Carver County				
Seminary Fen	Good	*Amphiagrion. saucium*		Medium
Dakota County				
Ravenna Tr. Sedge meadow	Maybe			Low-medium
Ravenna Tr. seepage meadow	A little		Yes	Low-medium
Sibley Fen	Reportedly present			Low
Gun Club North	Maybe			Low
Goodhue County				
Perched Valley WMA	Present		Probable	**Medium-high**
Red Wing 20	Good		Probable	Medium
Red Wing 21	Very good		Yes	**High**
Houston County				
Co Rd 249	Fair			Low
Highway 26	No			Low
La Crescent	Perhaps		Yes	Low-medium
Wildcat Hill	A little			Low
Mound Prairie	Some		Probable	Low-medium
Le Sueur County				
Ottawa Bluff	Good	*Somatochlora sp.*	Yes	**Medium-high**
North Ottawa	Good	*Somatochlora walshii*	Yes	**Medium-high**
Kasota 7	Good	*Sympetrum semicinctum*	Yes	**Medium-high**
Rice County				
Bridewater 34	probable		probable	Medium
Wabasha County				
McCarthy WMA	Seeps		Likely	**Medium-**

021				**high**
McCarthy WMA	Very good		Yes	**High**
022				
McCarthy WMA	Seeps		Likely	**Medium-**
023				**high**
Wabasha-	Possible	*Sympetrum*	Yes	Medium
Whitewater 1		*semicinctum*		
Wabasha-	Possible		Yes	Medium
Whitewater 2				
Snake Creeek	Present at times			Low-medium
Winona Co.				
Wiscoy Valley	Very good	*A. saucium, S.*	Reported by	**High**
East		*semicinctum*	owner	
Co. Rd 4	Very good	*A. saucium, S.*	Yes	**High**
		walshii,		
Money Creek	Reported seeps		Likely	Medium
Hwy 76 SW	Good	*Somatochlora sp., S*	Present across	**Medium-**
		semicinctum	property line	**High**
Hwy 76 NE	Very good	*S. walshii*	Yes	**High**
Lamoille	Good	*Somatochlora* sp.	Yes	**High**

Considered in isolation, the results could lead to the conclusion that Hine's emerald are absent from these MN sites. However, dragonfly numbers and diversity seemed unusually low at all of the sites in 2010. Repeat visits are sometimes necessary to confirm the presence of Hine's emerald. For example, Tim Vogt once surveyed the site that is now considered to have Missouri's second largest Hine's emerald population (Grasshopper Hollow) during ideal survey conditions (except it was after 1:00 PM), but he saw none (Tim Vogt, pers. comm.) . Since 1999 at least two new sites have been confirmed in Michigan at sites where Steffens (1999) saw probable Hine's emeralds (Point Detachee, Bois Blanc Island) or documented high quality habitat but no Hine's (Castle Rock I-75 Swales). The Hine's populations at the Wisconsin River sites appeared to be much smaller this year than in previous years and they were not observed at one site where they were present in 2009 (Bill Smith, pers. comm.). No more than two Hine's were seen simultaneously at any of those sites in 2010, in contrast to 2009 where they ranged from at least 3-4 to "many" (Sievert 2010, 2011). Something apparently suppressed the Wisconsin River valley populations this year; perhaps some of the potential Minnesota habitats, some of which are only 70 miles away, were affected by those same factors.

This may just have been a very bad year for Hine's in this part of its range. Minnesota might have smaller populations than Wisconsin due to fragmentation of habitat and/or because Minnesota is at the extreme western edge of *S. hineana*'s potential range. Any

additional suppression of the population by local environmental factors would make them even more difficult to detect. Some suitable habitat was found, so the most prudent course would be to revisit the best sites again.

Some of the sites had relatively poor habitat quality, especially in Houston County. This is unfortunate because they are also the closest to the Wisconsin River sites. Perhaps there is better potential in several private seepage meadows along Highway 249 in Houston County (Steffens 2010) where dragonfly surveys were not conducted in 2010.

Winona County has the most concentrated cluster of potential habitats and these sites are only 70 miles from the nearest known Wisconsin sites. Surveys are just getting started in adjacent parts of Wisconsin, so the actual distance may be even less. Lamoille (Figure 42) was perhaps the most tantalizing and frustrating of sites. Unidentified larger *Somatochlora* were seen multiple times. My best guess is that these were *S. williamsoni*, but even if they were this would add a Hine's associate to the list for the site. I recommend this site be surveyed for adults again. It is not very efficient to conduct larval surveys in search of new Hine's emerald sites, but it might be considered here if additional adult surveys fail to identify the unidentified *Somatochlora* species I saw in 2010.

Follow-up surveys should be conducted in Winona County at the Highway 76 NE and Highway 76 SW sites (Figure 39), Co Road 4 site (Figure 36), and the Wiscoy Valley East fen(Figure 34). Another small calcareous fen occurs in a farmer's field in this township. This fen is known as Wiscoy 15 on the DNR Calcareous Fen List. It is owned by a farmer who did not return calls. Rumors are that he is unlikely to cooperate, and that he mows closer and closer to the fen each year. Judging from the road ¼ mile away and aerial photos, the rumor appears to be true.

The McCarthy Wildlife Management Area (Figure 29, Wabasha County) and Red Wing 21 fens (Figure 14, Goodhue County) are high quality, and should be ranked with Winona County sites in any follow-up efforts. Site 022 at McCarthy was particularly promising. After surveys were completed, it came to my attention that the far NW end of McCarthy WMA, in Section 2, is considered by some to be a calcareous fen. Based on what I saw at site 022 this is not surprising. That too should be investigated and surveyed.

There are a number of other calcareous fens in the SE that were not surveyed. Olmsted and Fillmore counties have at least 10 combined, but since most are isolated in a sea of agriculture these were bumped off the high priority list for this year. If Hine's emerald is eventually found elsewhere in the SE, these small isolated fens should be considered again. But surveying small, isolated, probably degraded fens surrounded by intensive agriculture did not seem like the best strategy for finding Hine's emerald in MN. Houston County also has 2 small, private, isolated calcareous fens. The owner of the larger one (Houston 26 Fen) declined permission to survey, but sounded like he could be persuaded with some more effort. But the site did not look good enough on aerials to put forth that extra effort. He reported that the fen seems to be getting wetter to the point of flooding a bit, and that woody encroachment is increasing.

Moving west to Rice County, the Cannon River Wilderness has several fens and seepage/sedge meadows in a relatively wild, protected part of the watershed. Only one of these was surveyed, and they are all somewhat difficult to access either through private land or by boat. These should at least be evaluated and checked for crayfish. They are mapped under the Rice County site descriptions below (Figure 27).

The Le Sueur County sites (Figures 21, 23 and 25) all had good habitat. *Somatochlora* were present at 2 of the 3 sites, and crayfish with small seepage channels were present at all 3. Many hours were spent surveying the large Ottawa Bluff Fen and seepage meadows, but only a single *Somatochlora sp*. was seen. Fortunately, the largest and most voracious populations of mosquitoes and biting gnats south of the tundra *were* discovered there. These sites look as good for *S. hineana* as any in Minnesota, but because they are so far from any known sites (~180 miles) and so close to the Prairie Parklands Province I would rank them slightly lower for follow-up priority than the other high priority sites.

There were once thousands of acres of calcareous seepage fens along the Minnesota River from Chaska in Carver County all the way to the Mississippi River confluence. Only a few degraded fragments remain. This area probably had the best potential habitat for *S. hineana* in Minnesota, and a lot of it. Of those thousands of acres, perhaps only a few dozen acres at Seminary Fen have much potential for Hine's emerald. If permission can ever be obtained to survey the private fens there, surveys should be done. Savage Fen was surveyed in 1998, but perhaps a shred of habitat was overlooked there. With the metro population nearby and recent public interest in dragonflies perhaps local volunteers can monitor the Twin Cities area fens. There are dragonflies there to watch, and Hine's emeralds have turned up in some strange places. All of these calcareous fens and former fens have relatively easy access, and roads, rails and trails that pass right by.

Stearns County is a bit outside the current study area, but it has very intriguing habitat in the St. Wendel Scientific and Natural Area. Minerotrophic tamarack swamp and calcareous seepage fens mingle there. It was on the low end of the priority list for surveys this year but did not get surveyed. Like the Le Sueur sites it may be pushing the western range limits a bit, but the habitat sounds promising.

In hindsight, and after two visits to the Wisconsin River sites, I'm confident that the best sites were chosen for these surveys. With a few supplementary sites mentioned in the preceding paragraphs and perhaps some of those in Steffens (2010), the high priority sites in Table 1 remain the best sites to look at again. Although they have crucial similarities to the Lower Wisconsin sites, there were differences too. They occur in a more fragmented Minnesota landscape, and except for Wiscoy Township many of the best sites are isolated from one another. Most of the large river terrace fens are now degraded.

A few SE residents mentioned that the seeps and springs in the area are pretty constant year round, unlike some Hine's sites that dry up in summer. The Lamoille site was definitely dryer in late July, and the Snake Creek site showed signs of seepage but was completely dry at the time. The calcareous seepage fens seemed to have rather constant

groundwater discharge, as well as the best peat, whereas groundwater is often intermittant at Hine's sites in other states. None of the calcareous fens appeared too wet for *S. hineana* but perennial groundwater discharge may be a difference between the Wisconsin *hineana* site and the potential sites in Minnesota.

Survey site descriptions and results

Carver County

Seminary Fen. T116N R23W, S34, 35. June 30, 1000-1800. 75 degrees, a few clouds. This fen is reportedly the highest quality calcareous fen that remains of the many river terrace fens that once existed in Carver, Scott and Dakota counties. Much of the main, 37 acre calcareous fen is on private property; permission to survey was denied. The owners also own another calcareous fen to the west a short ways. (Figures 6 and 7). The rest of the fen is owned by the State of Minnesota and Hennepin County Regional Railroad Authority. Only the edges of the best fen habitat and most of the lower quality/degraded surrounding seepage meadows on state land were surveyed, but good observations of the larger calcareous fen were made from the property line. There is a third small calcareous fen south of 212/Stoughton Rd (Figure 7) but it could not be distinguished from surrounding habitat.

Seeps and their subsequent trickling streamlets and small areas of sheet flow irrigate the fen and parts of the meadows around it. Species such as *Carex sterilis* and *Eloecharis rostellata* are found here. Invasive species such as reed canary grass and buckthorn have also infested much of the area outside the private fen. *Anax, Aeshna, and Celithemis spp.* were all common. Hine's emerald associate, *Amphiagrion saucium*, was present in the fen, which looks to be high quality and somewhat reminiscent of Michigan Upper Peninsula *hineana* fens.

After five hours in the meadows, the late afternoon hours were spent searching for feeding *Somatochlora* along the RR grade/trail WSW of the main fen. Only the same taxa mentioned above, minus *Amphiagrion*, were seen.

The private fen is the highest quality fen seen near the Twin Cities during 1998 or 2010 surveys, and perhaps it has the crayfish burrows that were not found elsewhere at the site.

Figure 6. Seeps and sedges at the edge of Seminary fen

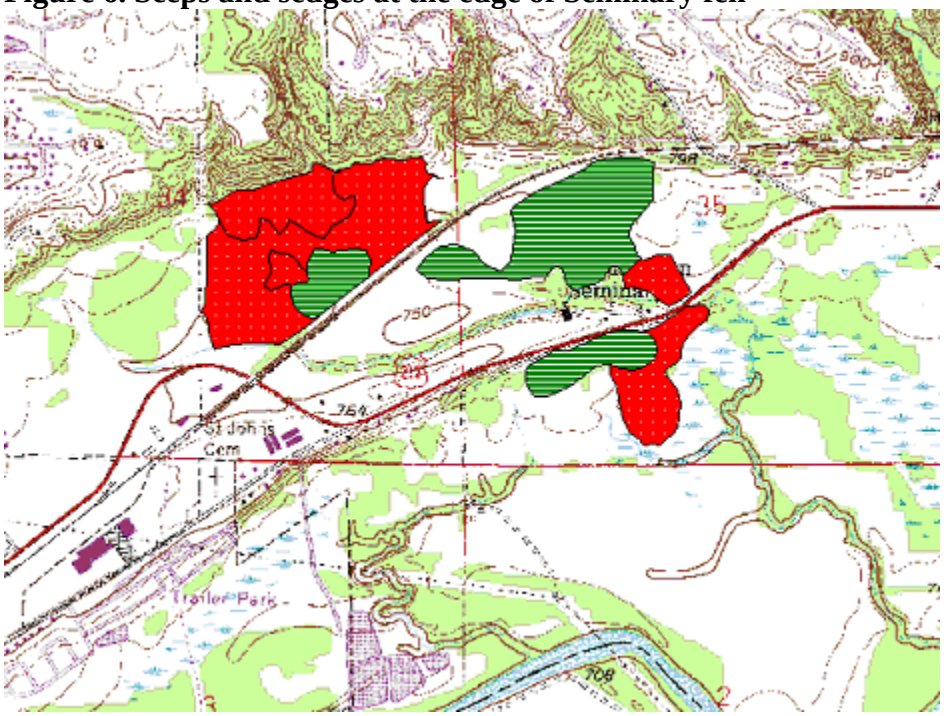

Figure 7. Seminary Calcareous Fen (green) and (some of) the adjacent seepage wetlands (red). The larger, central fen and the small one to the west are privately

owned. The third one (south of U.S. Highway 212/Stoughton Road) was not distinguishable in the field from surrounding wetlands.

<u>Dakota County</u>

(2) Ravenna Trail sedge meadow and Ravenna Trail seepage meadow. T114N R16W S16SW, S21. June 21, 1230-1430. Cloudy, 100% RH, 80 degrees F.
This Mississippi River terrace wetland is mapped as emergent marsh, and is mostly submerged, unsuitable habitat. It is privately owned. The far NW end is more of a seepage meadow, with a small seep or spring fed, sand-gravel bottom streamlet running through it. Willows, cattails, Joe Pye weed, arrowhead (*Sagittaria* spp.) and crayfish chimneys were present. It may be marginal habitat. The state owned Ravenna Trail sedge meadow was without surface water but had a saturated peaty, substrate that is likely fed by circumneutral seepage from adjacent uplands. Spikerushes, cattails, arrowhead, and diverse forbs were present (Figure 8), though crayfish sign was not noted. Conditions were not optimal but dragonflies were active. *Anax junius* and *Plathemis lydia* were observed. These two sites might be worth revisiting when conditions are wetter and weather is better, though neither rank among the best sites.

Fig 8. Ravenna Trail Sedge Meadow

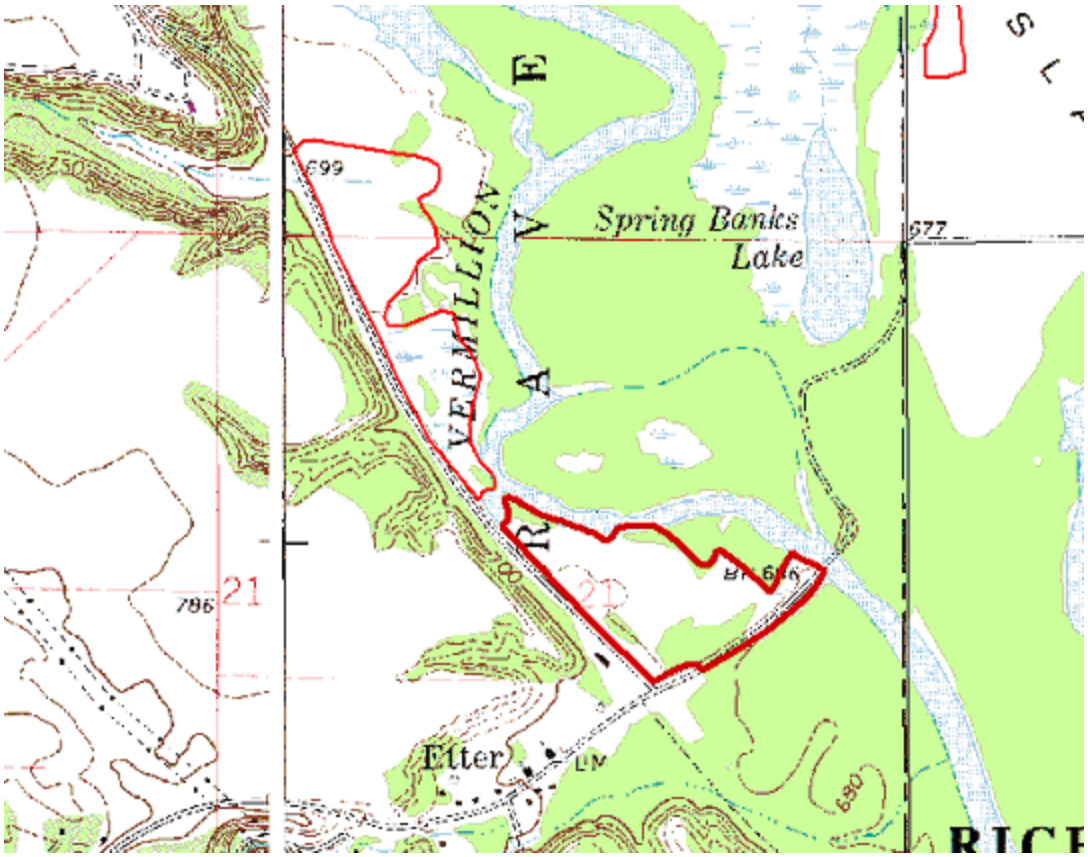

Figure 9. Ravenna Trail emergent marsh with small seepage meadow (upper site) and Ravenna Trail sedge meadow (lower).

Gun Club North/Quarry Island Calcareous Seepage Fen. T28N R23W S33. July 8, 1400-1800. 78 degrees, 20% cloudy.

This Fort Snelling State Park site is more properly called a former calcareous fen, as there appears to be just a seepage/sedge meadow now, and not a very good one at that. There is some name confusion surrounding this site so I offer two names that have been used but no guidance as to which if either is "correct". Like all of the once pristine calcareous fens near the Twin Cities, the site has been affected by urban growth, roads and railroads. Invasive and weedy species have taken over much of this site. *Phragmites* and reed canary grass (*Phalaris*) abound, and in less disturbed spots extremely dense *Typha*, some broad leafed sedges and arrowhead, with turk's cap lily, Joe-pye weed, jewelweed, and water dock (*Rumex*). The substrate is moist but no flow was visible; the site is certainly fed by seepage from adjacent uplands, although it may be less than what it once was. No crayfish burrows were seen. Sandwiched between the river below and miles of urban development above, this former calcareous fen is probably marginal *hineana* habitat. Some *Aeshna* were seen.

Figure 10. Gun Club North Fen

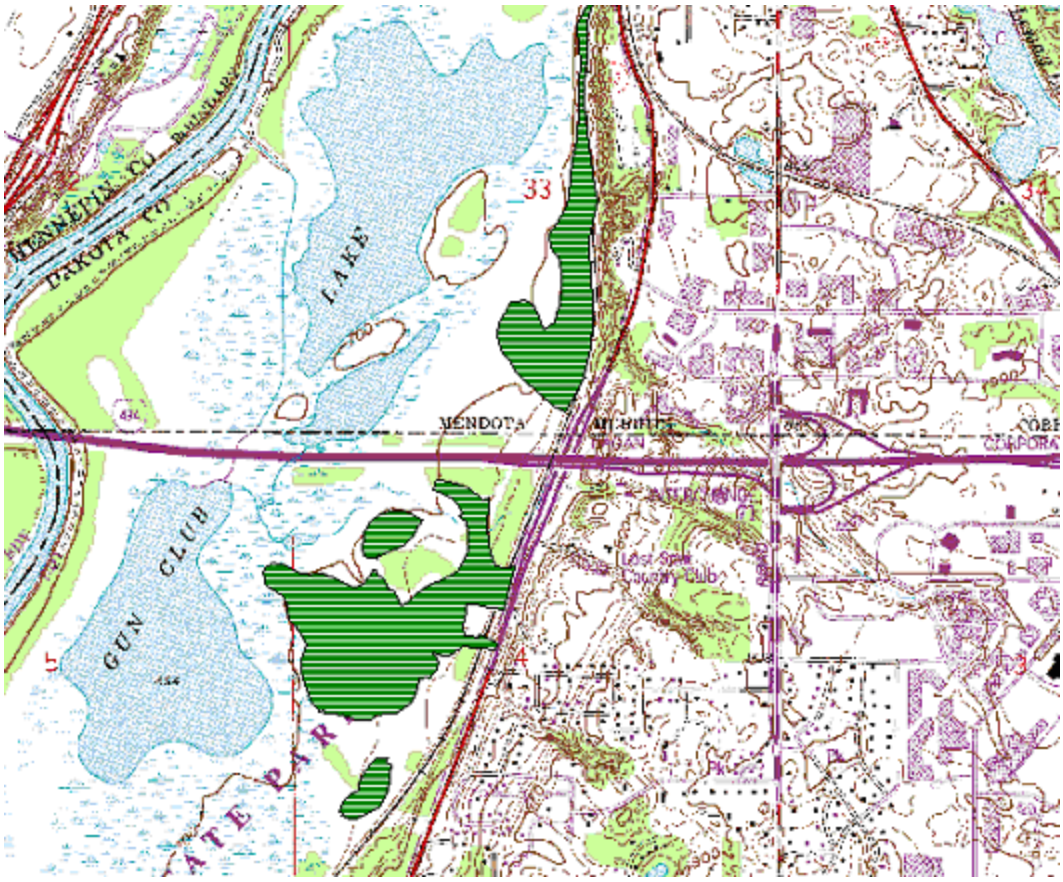

Figure 11. Gun Club North/Quarry Island Calcareous Fen (North of 494) and Sibley Calcareous Fen/Gun Club South (S. of 494)

Sibley Calcareous Seepage Fen/Gun Club South. T27N R23W S4 NW. July 9, 0915-1100. 75 degrees, clear.
Like Gun Club, this Fort Snelling State Park site was also a large and pristine calcareous fen many years ago, but is mostly degraded now by invasive species, woody encroachment, surrounding development and possibly by changes in groundwater quality and quantity. Rich Baker (MN DNR), Phil Delphey and Nick Rowse (USFWS) and Mark Cleveland (State Parks) were also present. Although groundwater seepage is known to be present, we could not find the source on this visit. No signs of crayfish were found. The least disturbed part of the site is a long way from the nearest forest cover on upland slopes to the east, presenting a possible problem for the edge-loving *S. hineana*. There was nothing too promising here - it is difficult to call this anything but marginal habitat for Hine's emerald at this point, though efforts are being made by state parks to preserve the best parts and remediate disturbed parts of the site. We saw *Libellula pulchella*, *Anax junius*, *Sympetrum*, and damselflies.

Goodhue County

Perched Valley Wildlife Management Area, calcareous fen and seepage meadow. T112N R13W S8 SW, SE. (Fig. 12); 30-40% cloudy, 75 degrees, June 25, 0900-1200. Reed canary grass is destroying parts of this site. There is or was a small, 1.9 acre

calcareous seepage fen here, within a much larger southern seepage meadow/carr. I am not certain I found it. I made the mistake of entering from the north – it would better to enter from the south. The southern seepage meadow produces tremendous plant height. *Typha*, *Salix*, and Joe-pye weed are spread throughout and *C. stricta* and large hummocks are common. The combination makes the site extremely difficult to walk though. There is a small (2'x 4") sluggish flowage in the center that is presumably seep or spring fed. There is good mucky-peaty substrate. Although crayfish burrows were not seen, the habitat appears such that they are very likely present. A few *Aeshna*, *Sympetrum*, and *L. pulchella* were seen. Time and weather ran out on an intended return visit in July. The site might be worth another look, especially near the fen.

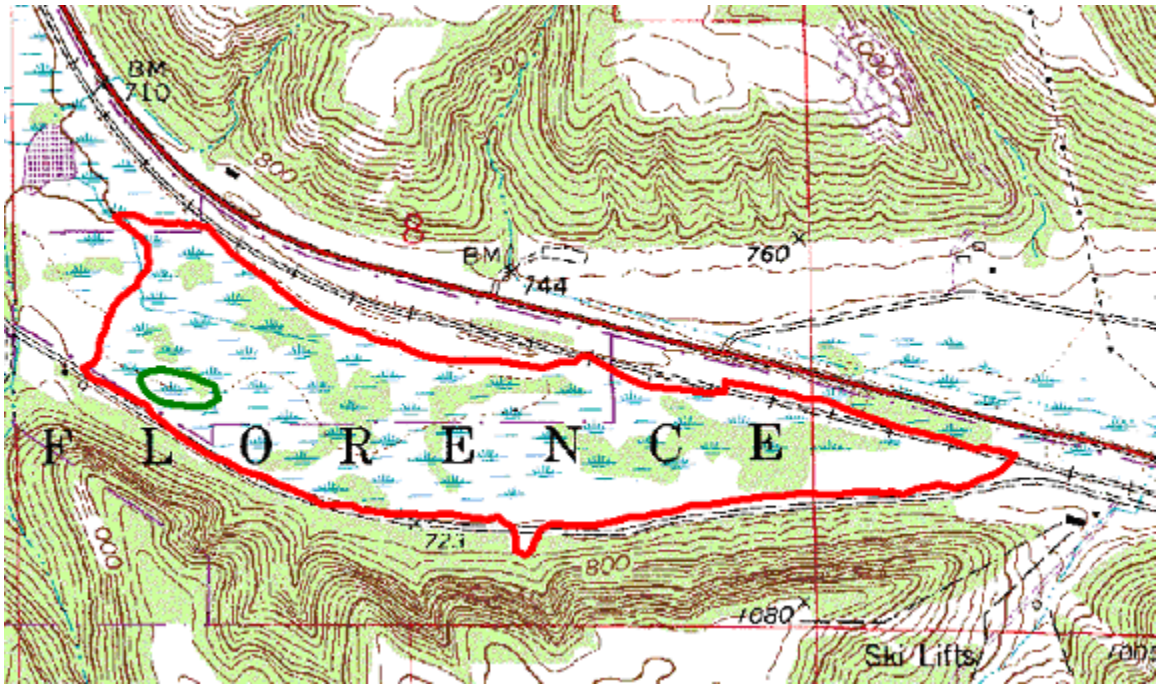

Figure 12. Perched Valley WMA calcareous fen (green) and seepage meadow

Red Wing 21. T113N R15W S 21SE. June 25, 1200-1330. Cloudy with thunderstorms building, 80 degrees. This is a good quality calcareous seepage fen (Figure 13). *Typha*, *Sagittaria*, *Carex stricta*, *Rumex orbiculata*, *Eleocharis*, *Salix*, jewelweed and Joe-pye weed are all common, and reed canary grass is a problem in spots. There is active seepage from the wooded slopes to the south that flows in a small streamlet north from the south unit of the fen, and under a floating mat that is weak and thin in spots. Crayfish burrows are present and the site looks as ideal for *S. hineana* as any site in Minnesota. Survey weather was not ideal, but *L. pulchella* and *Tramea lacerata* were seen.

July 21, 1500-1730. 88 degrees, clear. This should have been a good afternoon for feeding *Somatochlora* along the Cannon River Trail that bisects the fen, but not one was seen. A few *Anax*, *Sympetrum* and *Tramea* were present but dragonfly activity was minimal.

This site needs a survey during the morning hours.

Red Wing 20 T113N R15W S 20SE. June 25, 1345-1415, cloudy 80 degrees. This southern seepage meadow/carr lies a short distance west of the Red Wing 21 Calcareous Seepage Fen (Fig. 14), in a nearly identical geologic/hydrological setting. Springs and seeps occur all along the upland edge, flow under the railroad grade turned Cannon River bike trail, and into the meadow. The seepage meadow appears much less interesting and diverse botanically than Red Wing 21, but was only evaluated from the grade as thunderstorms had arrived. This may be suitable habitat but is much lower quality than Red Wing 21. The bike trail actually makes an ideal place to survey for afternoon-evening feeding *Somatochlora*, though none were present. This and Red Wing 21 are owned in part by DNR, Lutheran Social Services of St Paul, and the Anderson Center of Red Wing.

July 21, 1730-1830, clear, cooling down from mid 80's. Conditions were good, and the trail past the seepage meadow was walked several times in search of feeding *Somatochlora*. None were found.

Fig 13. Red Wing 21 Calcareous Seepage Fen, looking south from the Cannon River Trail

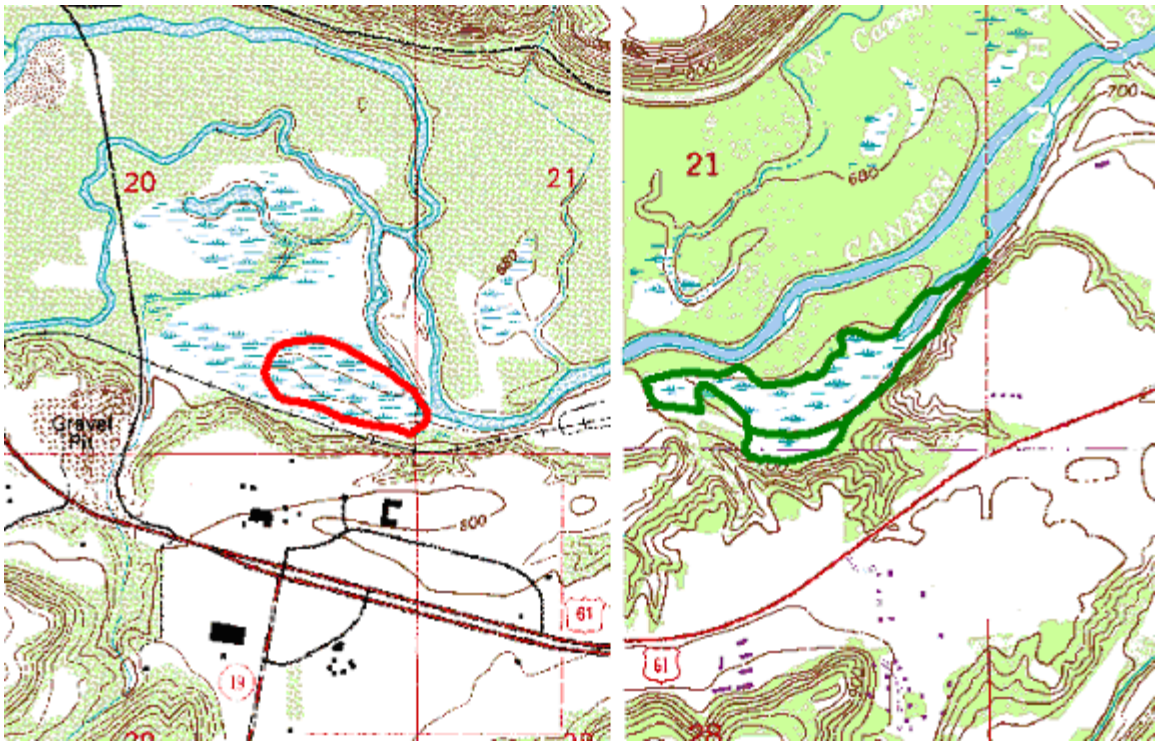

Figure 14. Red Wing 20 Seepage Meadow (red) and Red Wing 21 Calcareous Fen (green)

Houston County

County Rd 249 wetland. T102N R04W S29 NWSE. June 24 0900-1030, 75 degrees, clear. This site is on state forest land. Although it looks good from its setting and from the road, the site was poor habitat. It is grassy, with patches of cattails and some Joe Pye Weed and asters. The site suffers from flash flooding, possibly exacerbated by extensive agriculture on the plateau above the drainage, and the site was flooded quite recently. There are some icy cold, obviously spring fed streamlets and creek (the sources of which are apparently well upstream), but there is no peat or muck layer, just very hard and compact sandy soils with a little silt. No evidence of crayfish activity was found. Not worth revisiting. *Aeshna*, *L. pulchella*, and *Plathemis* were seen.

There are also privately owned seepage wetlands off the main road in the County Road 249 corridor, but these were not evaluated as the owners could not be contacted.

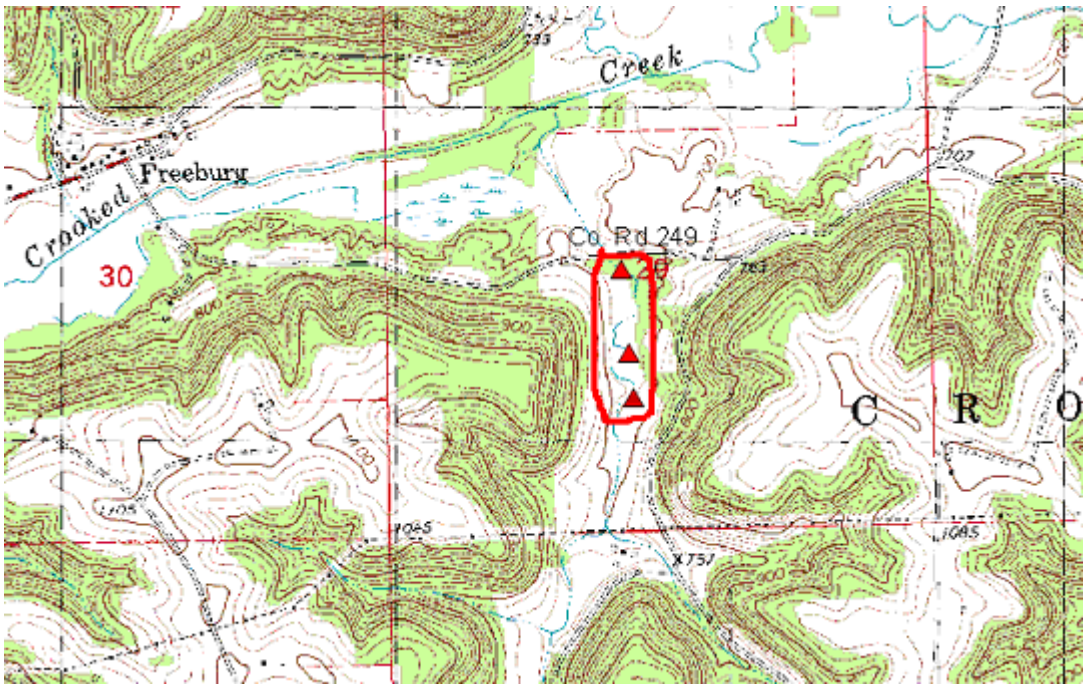

Figure 15. County Highway 249 Wetland

Highway 26 Seepage Meadow T101N R04W S14 SWSE. June 24. 1200-1230 78 degrees, clear. This site is in the Upper Mississippi River National Wildlife and Fish Refuge (UMRNWFR). It is mapped as southern seepage meadow/carr, but that is debatable. No seeps were seen, though some could occur from the hillside adjacent to the site. There was knee deep standing water, the bottom was quite hard with apparently no muck or peat. No flow was evident. There was no crayfish sign but it may have been well under water. *L. pulchella, A. junius and Sympetrum* were the only dragonflies seen.

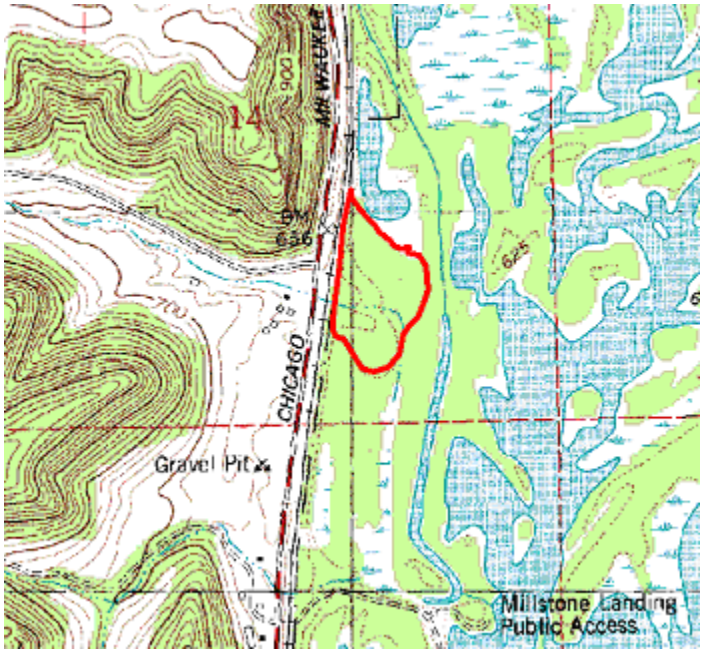

Figure 16. Highway 26 Seepage meadow

Wildcat Hill T103N R04W S26 SE. July 24, 1400-1600. Clear, 77 degrees. Like the other Houston County sites, this one looked promising from aerial photos and driving by, but upon closer examination the substrate was found to be hard and compacted, with no evidence of crayfish. The site is not habitat typed, but has characteristics of southern seepage meadow/carr. One seep was found on the south edge where the wetland abuts the slope, but not much flow was present. There is some *Typha*, and a lot of grasses including reed canary grass. This private site is rented as pasture. This is probably marginal habitat. *Aeshna* and *Sympetrum* were present. There are many springs in this general area on karst GIS layers, so small patches of suitable habitat on private lands could easily have been overlooked.

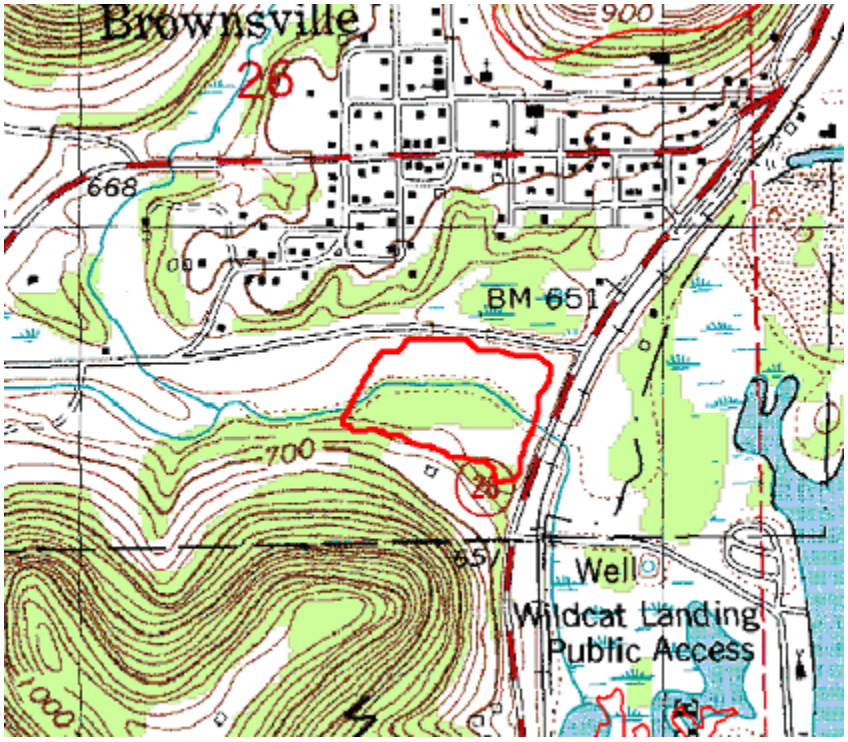

Figure 17. Wildcat Hill seepage wetland

La Crescent wetlands T104N R04W S22 SE and NE. June 24, 1800-2000, clear, mid-70's.

This large UMRNWFR site is a mixed emergent, northern bulrush-spikerush marsh dominated by *Typha*, *Phragmites*, *Scirpus*, *Sagittaria*, and Joe-pye weed at the survey points. Very large crayfish burrows were present-*Procambarus acutus* occurs in the Mississippi River floodplain (Helgen 1990), and it is possible these belonged to that species. There is some seepage from upland slopes to the west, but not much. The site was rather dry with little surface water and no surface water except at the base of the upland slopes. The substrate was moist muck and silt though, and being in the Mississippi River floodplain it may flood regularly. It did not appear high quality due to hydrological shortcomings and dense stands of *Phragmites*, but there may be some potential here. Only a few damselflies and *Tramea lacerata* were seen.

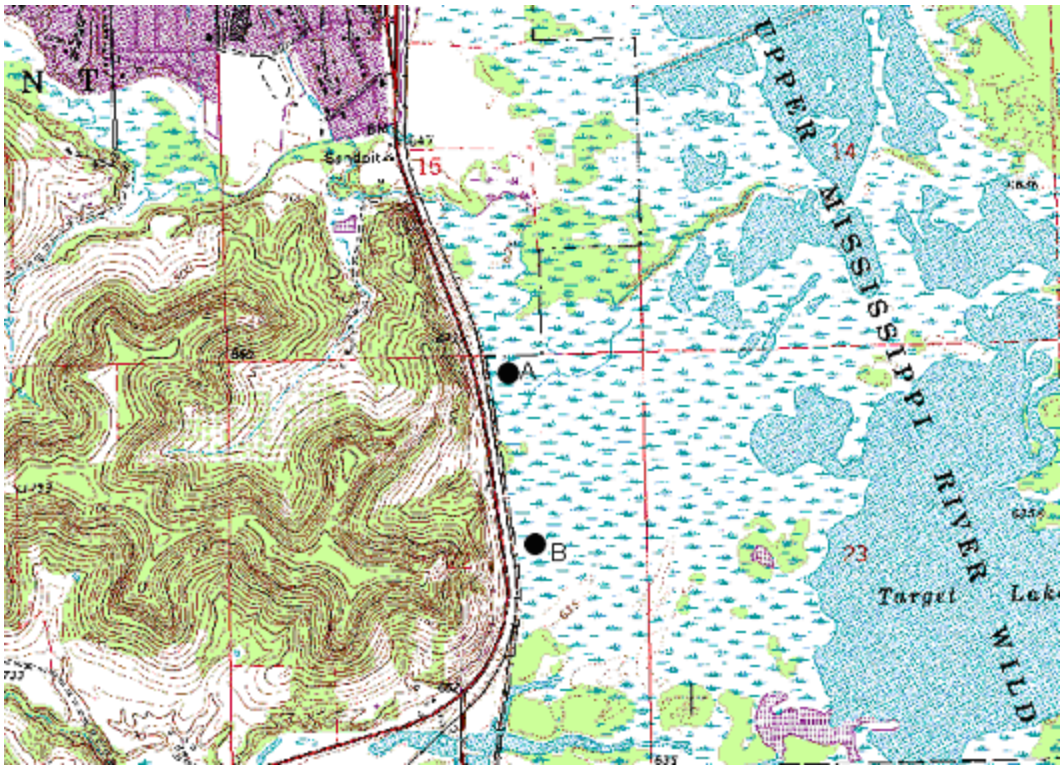

Figure 18. La Crescent Marsh. Surveyed between points A and B

Mound Prairie seepage wetland. T104N R05 S35 SW. June 23. 1700-1900. 78 degrees.

This state owned site is mapped as a sedge meadow and seepage meadow/carr. However, what was also mapped by the county as public land to the south turned out to be private, so there was no practical way to access the seepage meadow in the time available. From a distance it appeared to be just an unsuitable swath of reed canary grass, so an area of cattails/sedge meadow was surveyed near the highway instead. Conditions were less than ideal with rather strong winds, but the huge, dense cattails made effective surveys essentially impossible anyway. There is seepage running under the road and into the cattails from the hillside to the south, but it disperses there and no surface water or flow was evident once it entered the *Typha*. A couple of *Aeshna* and one *Plathemis* were seen along the road. Not a great site though there is a lot of wetland in the area and seeps are likely, so there may be some better habitat. No crayfish evidence seen, but they must be present in this large wetland.

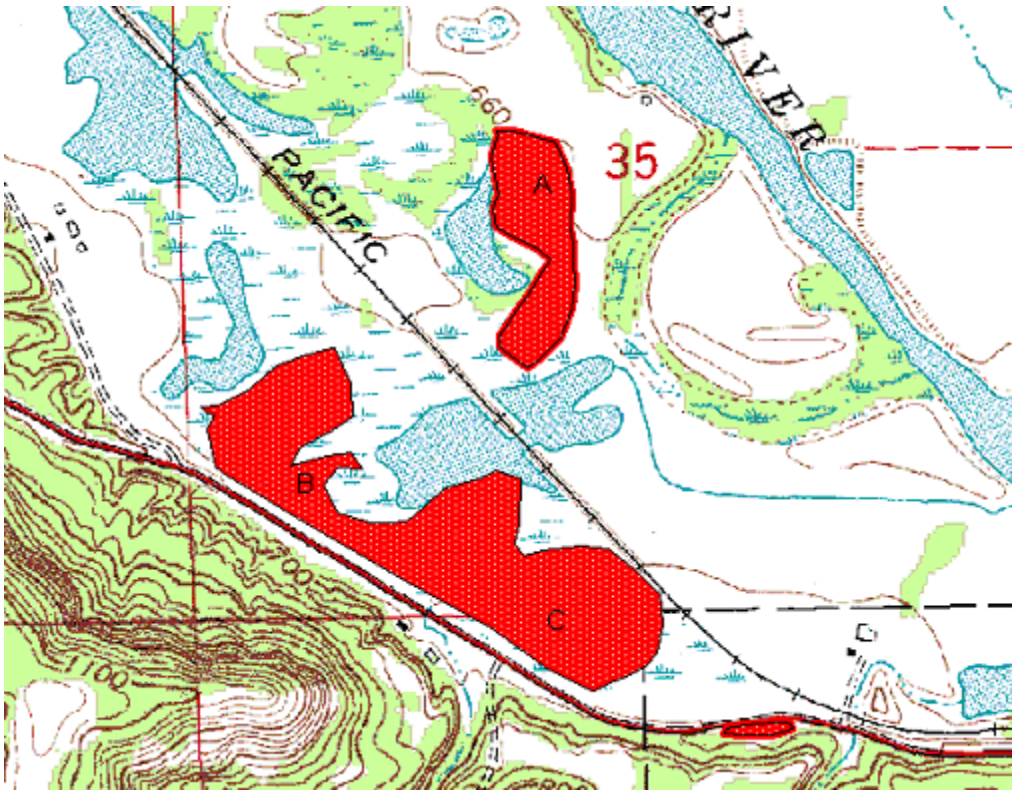

Figure 19. Mound Prairie. "**A**" was the unattained seepage meadow. The sedge meadow was surveyed between **B** and **C**.

Le Sueur County

Ottawa Bluff Calcareous Seepage Fens and southern seepage meadows. T110N R26W S14 NE, S11 SE. July 5. 0900-1300. 75 rising to 85 degrees, partly cloudy becoming mostly clear by 1000.

This large Minnesota River terrace wetland complex (Figure 21) is owned in part by the state, and is partly private. Permission to survey a portion of the private land was declined, though the owner probably would consent if assured that property restrictions would not result. Parts of the calcareous fens and much seepage meadow occur on state land sandwiched between the private owners, and this is the area surveyed.

Seepage is present at several points on the east edge near the road, at the base of the bluffs. Seeps eventually form small streamlets that flow generally west. Several crayfish burrows were found near the source of the seeps, but were not found anywhere else. The site certainly appears to be suitable habitat, though it is at the extreme western edge of the potential range. Parts of the seepage meadows are infested with *Phragmites* and reed canary grass.

At 1100 a single *Somatochlora* with curved abdomen appeared and patrolled briefly over the edge of calcareous fen and seepage fen. It was probably too small to be *S. hineana*

and was probably *S. walshii*, but it failed to return for a positive ID. *L. pulchella* and *Anax junius* were present

1530-1700. Returned to survey the area surrounding where *Somatochlora* was observed, with no success.

1900-2030. Drove and walked the road adjacent to fens and meadows looking for feeding swarms or individuals, but none were present.

Juy 7. 0800-1145. 75-85 degrees, increasing clouds to >20%. Surveyed same area as 7/6, but further west to old RR grade. Lots of *Eleocharis* in this area, but no *Somatochlora.*

Figure 20. Ottawa Fen. Seepage flows left to right through this stand of *Typha,* and crayfish burrows occur near the tree line.

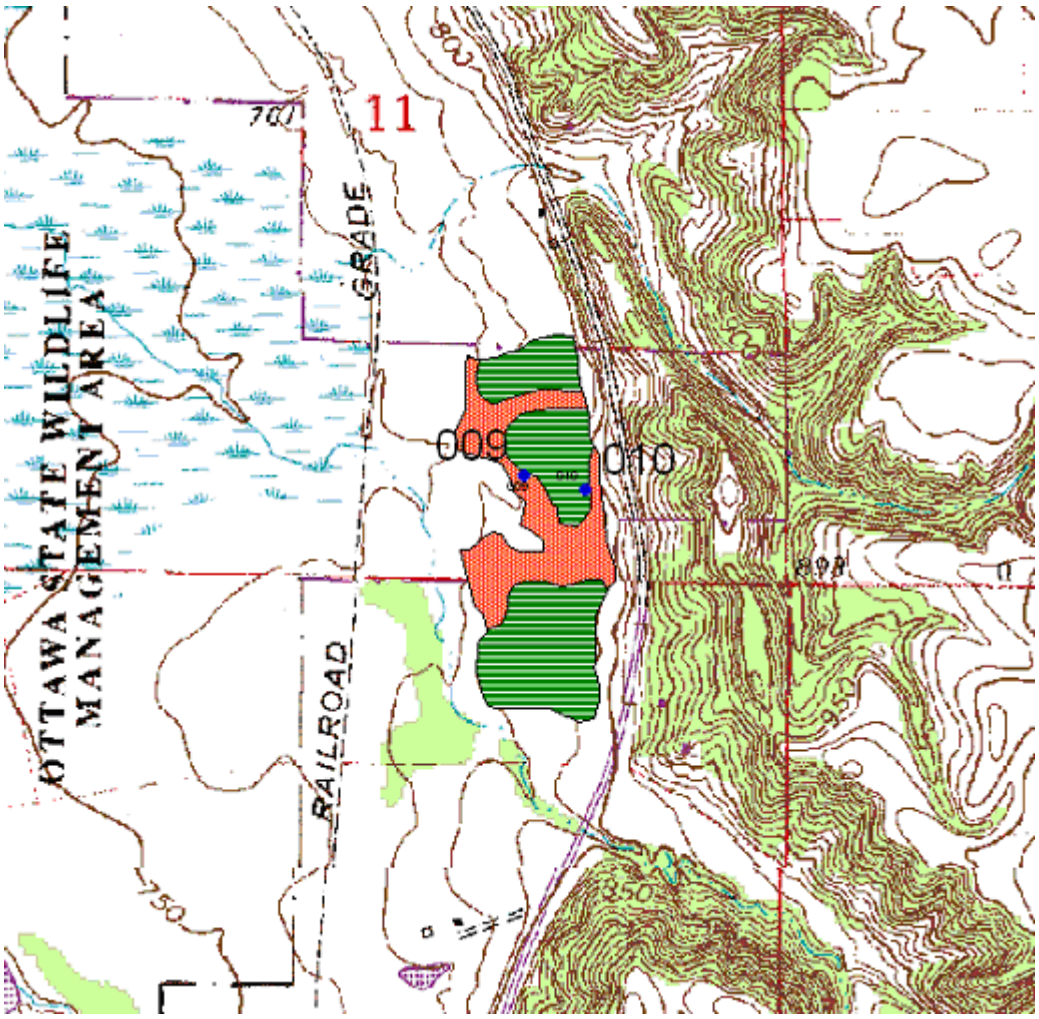

Figure 21. Ottawa Bluff Fens (green) and Seepage meadows (red). 009 is *Somatochlora* location, 010 is one of several seeps, and the only place crayfish burrows were seen.

Kasota 7 Calcareous seepage fen. T109N R26W S7 NW. July 6, 1415-1515. 85 degrees, 25% cloudy.

This is a tiny, <1 acre, high quality calcareous fen within an 8 eight acre southern seepage meadow. Like the other Le Sueur County sites, it is on the Minnesota River terrace just below carbonate bluffs. An ecologist's description of the site: "Fen in linear zone of emerging groundwater along base of bluff. Dom'd by *Carex stricta*, *Carex prairea*, *Carex sterilis*, and *Muhlenbergia glomerata*. Several typical fen species incl *Triglochin palustris*, *Lobelia kalmii*, *Aster borealis*. Small marly pools present". Some reed canary grass and *Phragmites australis* are also present, the latter being dense in spots. Crayfish burrows were seen near two seeps, which form seepage channels a few inches wide and deep (Figure 22). The site is owned by Unimin Corporation of St. Peters MN. I was escorted by Nick McCabe, a consultant for Unimin. This was just a brief visit to evaluate the site, squeezed between visits to Ottawa Bluff. *Libellula pulchella*, *Sympetrum semicinctum* and *Anax junius* were observed. Although the site is suitable habitat by all appearances, it also is the farthest west of any site surveyed. It is about 180 miles from

the nearest Wisconsin River *hineana* site, and is across the river from the Prairie Parkland Province. Just a brief reconnaissance was made during a time when the Unimin representative was available. I heard rumors that a new limestone quarrying operation might begin in the neighborhood, which could potentially impact the groundwater at this site.

Fig 22. Crayfish burrow (center) and tiny seepage channel (right) at Kasota 7

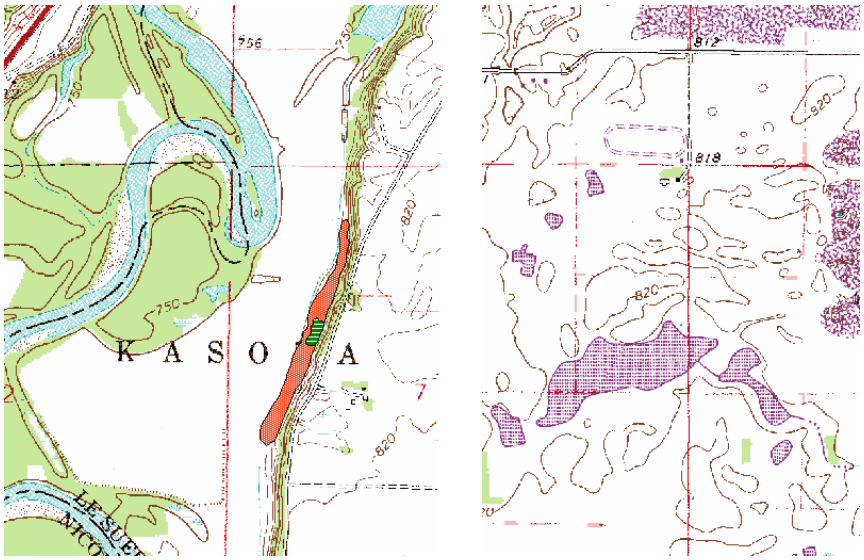

Fig 23. Kasota 7 Calcareous Seepage Fen (green) and surrounding seepage wetlands

North Ottawa Calcareous Seepage Fens. T100N R26W S3 NESE, NWSE
July 7, 1200-1500 and 1600-1815. 85 degrees, >25% cloudy.
This site contains two small, excellent quality calcareous seepage fens totaling less than 10 acres. It is similar to Kasota 7 and is privately owned by an individual who lives on adjacent land. At one time a few years ago the fens were actually watered by the DNR because of fears that groundwater drawdown could occur due to nearby quarrying activities. Watering no longer takes place, but there are still a couple groundwater monitoring wells. Crayfish burrows are present, and each of the two fens has an active seepage area where burrows are more numerous. The larger fen has a streamlet 1' X 1" deep that flows west from the seepage area. Like Ottawa Fen and Kasota 7, this river terrace site looks to be quite suitable habitat, with the same caveats mentioned for Kasota 7.

A single *Somatochlora walshii* male was netted and released. *L pulchella*, *Anax junius* and *Sympetrum* were also present.

Fig 24. North Ottawa Fens. *Typha* and lush growth of jewelweed at the seeps.

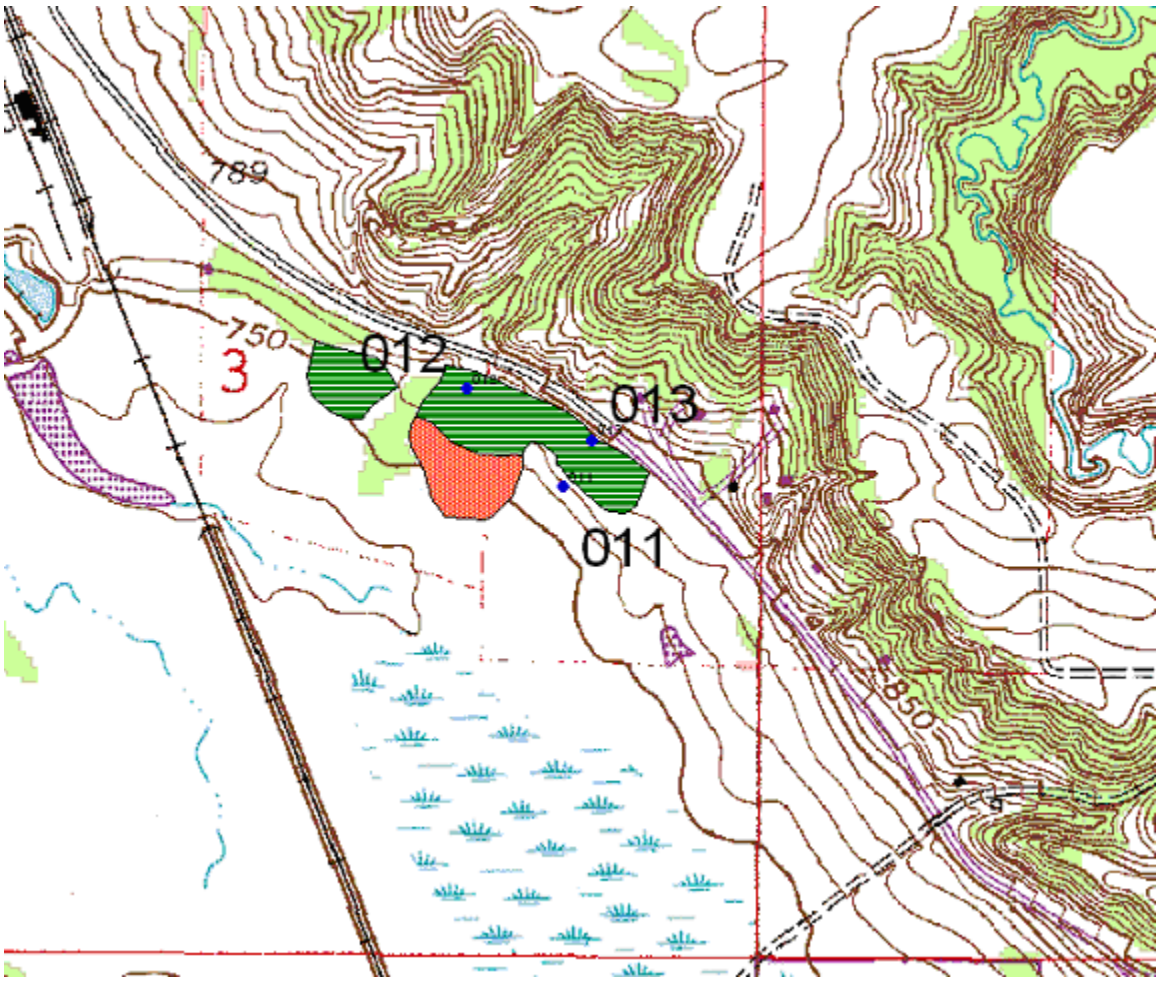

Fig 25. North Ottawa Calcareous Seepage Fens (Green) and Seepage Meadows (red). 011 and 013 indicate crayfish burrows. 012 shows the *S. walshii* location

Rice County

Bridgewater 34 Calcareous Seepage Fen and seepage meadow. T111N R20W S34NE July 8. 0900-1230. Clear, 77 degrees.
This is a 9 acre calcareous seepage fen embedded in 40 acres of southern seepage meadow/carr, tussock sedge subtype. It is owned by Rice County. The site is extremely "tussocky" and vegetation is extremely dense to the point where it may be difficult even for a species like *S. hineana* to oviposit. There is woody vegetation in much of the site, making it more carr-like. No surface flow of groundwater or evidence of crayfish was seen, though the fen's location next to the hills make groundwater discharge extremely likely. This is one of the rare sites where reed canary grass is absent, probably because it is over a mile from the nearest road, in the Cannon River Wilderness. It doesn't appear to be one of the best calcareous fens. *Libellula pulchella* was seen, as always. This fen is one of several seepage meadows and another much smaller calcareous fen that border a preserved, wild stretch of the Cannon River, so there may be some additional habitat in the area that should be evaluated. Most of these can only be accessed by boat or through private land that surrounds the Wilderness.

Figure 26. Bridgewater 34 calcareous fen

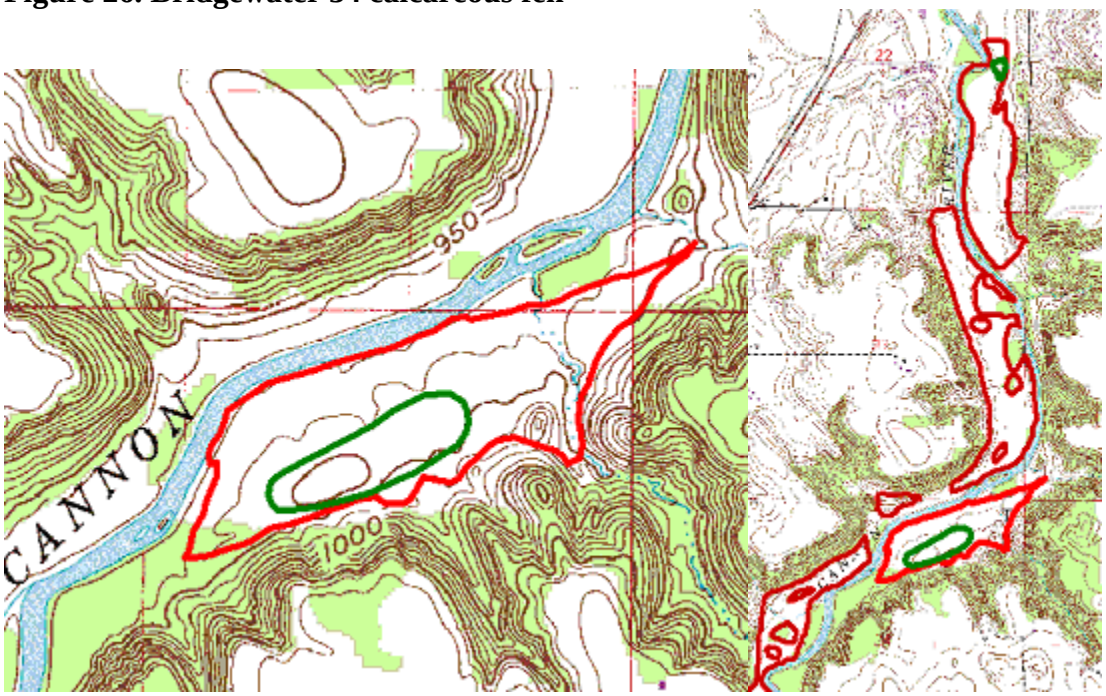

Figure 27 Bridgewater 34 fen and seepage meadow (left) and the same site with additional seepage meadows, sedge meadows, and another small calcareous fen in vicinity (right).

Wabasha County

McCarthy Lake Wildlife Management Area. T109N R10N S11 NE, S13 NW. June 21. This entire WMA (hundreds of acres) is mapped simply as "sedge meadow" on MCBS native plant GIS layers. A better description is found on the MCBS Map #13, Natural Communities and Rare Species of Wabasha County: "Meadow-marsh-swamp complex. Mosaic of wet meadow, emergent marsh and shrub swamp in old channels of the Zumbro River near its confluence with the Mississippi; wet meadow most often occurs as dense sedge mat floating on 2-5 feet of water; emergent march occurs where mat has disintegrated and around margins and open water…". Seepage from the adjacent slopes is very likely to occur along most of its western edge (Figure 29).

The plan was to devote at least an entire day to surveying/evaluating this very large site, but the lateness of the survey season and an extended forecast calling for nothing but poor weather forced a hasty partial day survey so that the high quality Red Wing 21 Calcareous Fen could also be surveyed again in the same day. Therefore, this quality site did not get as much attention as it could have. Due to the size of the site one could easily spend several days here.

Site 021. 0900-1000, clear, 80 degrees and rising fast**.** This rectangular, 3-4 acre seepage meadow is 0.9 miles north of Highway 14, its edges defined by dense stands of *Phragmites* and shrubs/trees. There is abundant jewelweed at seepage along base of uplands and patches of *Typha*, *C. stricta* and *Sparganium*. The floating mat is 2-3 feet thick. No flow is visible and no crayfish signs were seen, but it appears to be suitable *hineana* habitat assuming subsurface flow is present. *Anax junius* and *Sympetrum semicinctum* present. The 4 lane highway and railroad grade below it may impact the hydrology at all McCarthy WMA sites.

Site 022. 1005-1230. There are small trickling channels at this site, flowing almost imperceptibly at 0.3 m/minute. *Chara* grows in these channels, as it does in some Upper Peninsula *S. hineana* sites. Crayfish and crayfish burrows are present in the channels. Some time was spent dipnetting the channels but no dragonfly larvae were dredged up. *S. hineana* larvae are not likely to be found in July though. This is a *Phragmites* free zone in what appears to be a sea of *Phragmites* along much of the western edge of the McCarthy WMA. Unlike most of the sites, there is a lot of *C. lasiocarpa* here, and more floating mat. The mat grows weaker and more dangerous east from the RR grade. This is the best of the 3 McCarthy sites, and ranks with some of the calcareous fens and the Winona County seepage meadows in *S. hineana* potential. Other than *Sympetrum obtrusum* though, dragonflies were absent.

Site 023. 1240-1340. Temperature 85+. This site is treacherous with a very weak floating mat. If it can be judged by the sheer quantity of jewelweed and water dock, which were always most abundant near seeps during the surveys, this spot must have the most seepage of the 3 McCarthy WMA sites. There is a moat along the mat's disintegrated edge that makes getting onto the mat rather interesting. The moat combined with the

weak, wobbling mat easily qualifies this as the most exciting of all 28 sites. The dragonfly fauna was dull though, consisted of only *L. pulchella* and *Tramea lacerata*.

It was overlooked that a part of the WMA is on the state calcareous fen list, because it is not mapped as such in the MCBS plant community GIS layer that was the primary source queried for habitats. The fen is in Section 2 about 1.5 mile NW of Site 023. This should be revisited along with 022, at least.

Figure 28. Floating sedge meadows of McCarthy WMA Site 022 stretch far into the distance (above). *Chara* sp. (left) and young crayfish from seepage channels (right).

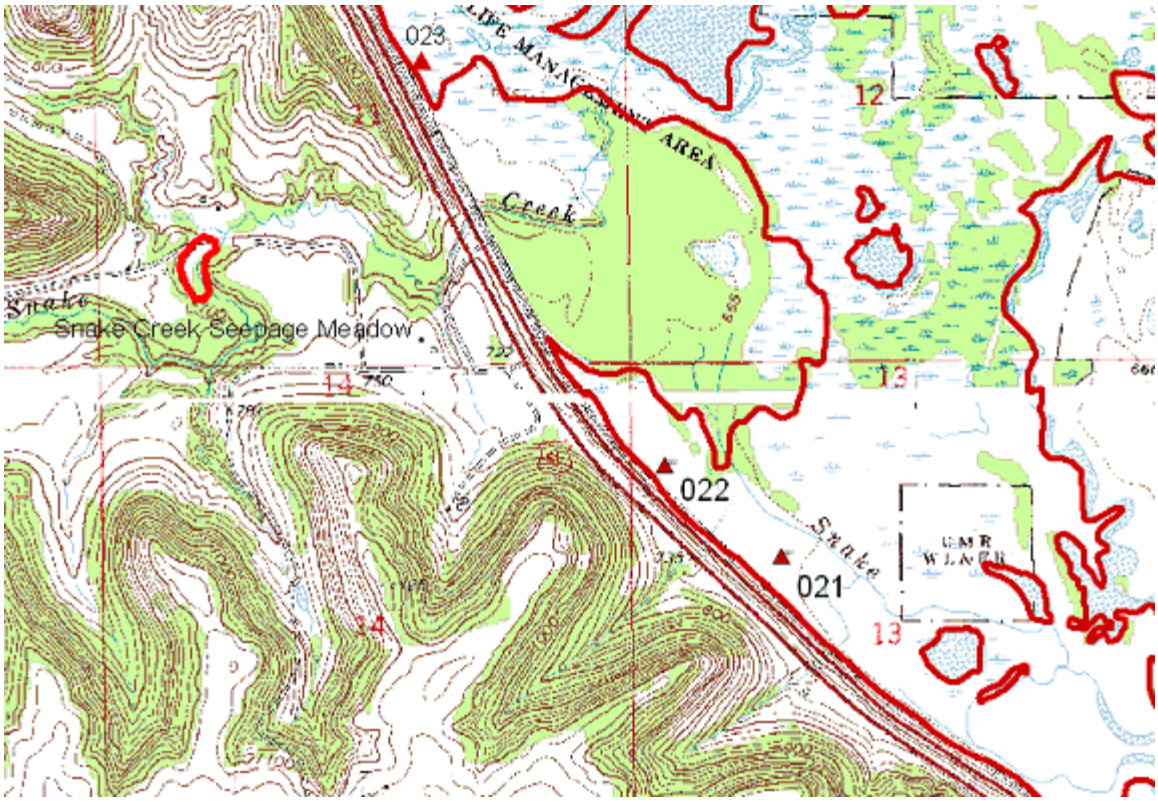

Figure 29. Snake Creek Seepage Meadow (at left) and the southern part of McCarthy Lake Wildlife Management Area. O21-023 are survey points. All of McCarthy is mapped as 'Sedge Meadow" but seepage is present (at least) along the western upland edge.

Snake Creek seepage meadow. T109N R10N S11SW. July 21, 1350-1450. Clear, 85 degrees. This tiny seepage meadow (Figure 29) is similar to though a bit dryer and shrubbier than other seepage meadows, with abundant *Carex stricta*, some *Typha*, *Salix*, Joe-pye weed, mint, jewelweed, and water dock. No crayfish burrows were found but there is a small dry seepage channel that looked like possible crayfish habitat. Only a few damselflies were flushed during this brief habitat evaluation. Probably not a great site on its own, but worth revisiting if *S. hineana* is ever found in the area.

Wabasha-Whitewater WMA Seepage Meadow #1. T109N R10W S36 NE.
Wabasha-Whitewater WMA Seepage Meadow #2. T109N R10W S36 NWSW
This state owned site(s) are southern seepage meadow/carr, tussock sedge subtype, that lie in the lower Whitewater River Valley. The valley is flanked by wooded carbonate bluffs and appears that it might once have held much potential habitat. However the hydrology of the valley has been altered extensively to benefit waterfowl and little potential habitat remains.

June 21, 2010. 1600-1800. Ca 80 degrees F. Partly cloudy (>25%). A late afternoon survey along the road was conducted for feeding dragonflies. Crayfish burrows were present on the edges of the road near the seepage meadows. Hundreds of *Leuchorrhinia intacta* tenerals were flying from the wetland to the wooded hills, but no *Somatochlora* were seen.

July 20.1700-1945. Clear, calm, humid, upper 70's to low 80s. Ideal conditions for late day feeding. Surveys started in Meadow #1, where there is much *Carex stricta* and *C. lacustris*, *Sagittaria*, *Rumex orbiculata*, jewelweed, Joe-pye weed, and some *Eleocharis*. No crayfish burrows were seen, but one possible burrow was felt by hand under the water and in such a large are of wetlands there is no reason to think they are not present. The meadow is quite wet but no flow was evident, though it certainly must receive seepage from the adjacent uplands. *Sympetrum semicinctum*, *Anax junius*, and *Celithemis* were present.

Surveys continued up the road past Meadow #2. Between 1900-1930 dozens of *Aeshna* and some Libellulids were gathered in feeding swarms over the road, but not a single *Somatochlora* joined them.

Figure 30. Wabasha-Whitewater Seepage meadow #2

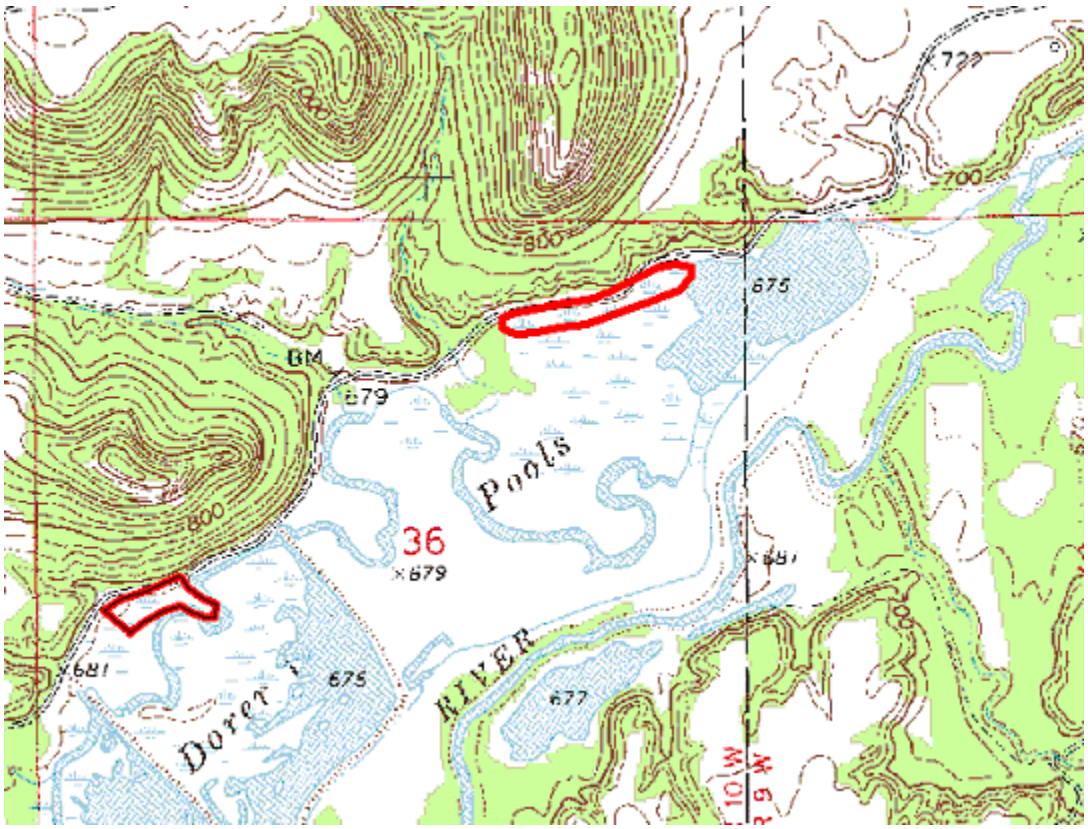

Figure 31. Wabasha-Whitewater Seepage Meadow 1 (right) and 2 (left)

Winona County

Wiscoy Valley East Calcareous Fen. T105N R07W S3SW. June 22, 0900-1300. 75-80 degrees, clear, humid. This small, 3 acre calcareous fen is privately owned. The owner lives adjacent to the fen and care takes it by removing invasive species and generally looking out for it. Although crayfish burrows were not found, he said crayfish are present. He also mentioned that the site occasionally experiences floods, but flooding is not sustained. *Carex stricta* is abundant, as is Joe-pye weed, and (according to the owner) *Carex sterilis* is present. There is a substantial seep area below the road that feeds a small streamlet (which flows into a trout stream) just south of the Headwaters Road, and more seeps and some sheet flow in the unmapped seepage meadows north of the road. The site certainly appears suitable for *hineana*, but *Somatochlora* were absent. *Libellula pulchella*, *Amphiagrion saucium* and *Aeshna* were present.

July 19, 1245-1430. Mostly cloudy, calm but dragonflies active. The seeps are still running quite strong, and apparently don't dry up as they do at some Hine's emerald sites. *Anax junius, Sympetrum semicinctum* and *Libellula pulchella* were active in and near the fen and upstream seepage meadow.

This site appears to be excellent potential habitat, although the perennial nature of the seeps is a question mark. No crayfish signs were seen on this visit either.

Figure 32. Wiscoy Valley East Calcareous fen, looking SW from Headwaters Road

Figure 33. Unmapped seepage meadows northwest of Wiscoy Valley East Fen

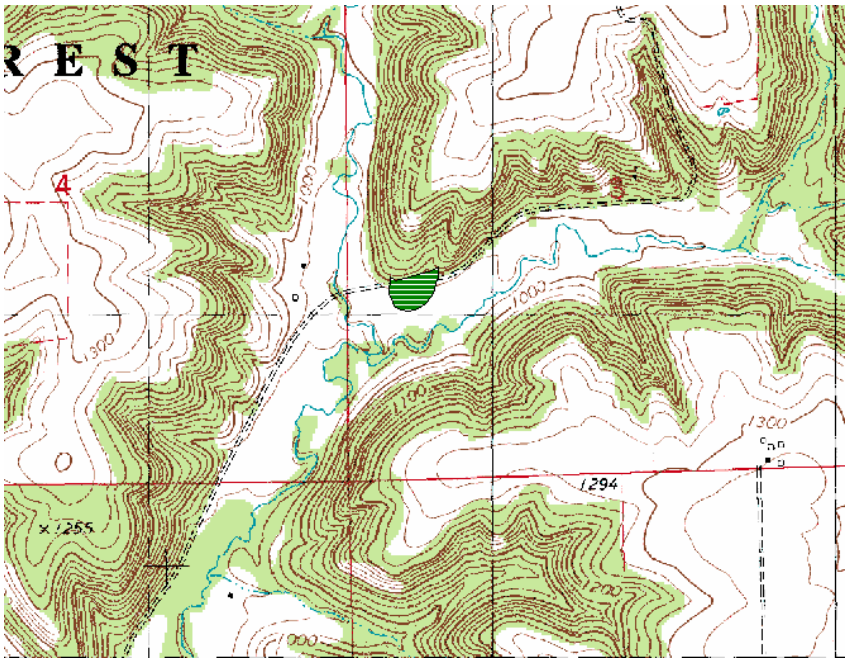

Figure 34. Wiscoy Valley East Calcareous Seepage Fen. Unmapped seepage meadows extend up-creek to the NNE a hundred meters or more.

County Rd 4 sedge meadow. T105N R07W Section 29 NW and 30 NE.
June 22 1330-1530, 1940-2025. 80 degrees, few clouds.

This privately owned, relatively large wetland is about .4 miles long from W to E, and may continue further south onto private property for which access was denied. This is classed as a northern seepage meadow/carr, sedge meadow subtype, and with its abundant seeps and relatively pristine surroundings, it appears to be one of the better potential habitats for Hine's emerald. Wooded carbonate hills flank it to the north and south. There is an area of seepage at the west end, and another area of very active seepage in the east half. Small, shallow streamlets (1' x 2-4") form at both seepage areas and trickle slowly east through the wetland (Figure 35). Diffuse seepage probably underlies the entire wetland. Crayfish are present. Six to seven foot tall cattails cover much of the eastern 2/3, which is fringed by *Carex stricta* and Joe-pye weed and a multitude of native prairie forbs along the open slope to the north. Cattails merge into graminoid sedges and forbs toward the west end. jewelweed and water dock are found throughout, but especially at the seeps, and in some portions rice cutgrass or *Eleocharis* are locally common. *Phragmites* and reed canary grass are apparently absent, a welcome rarity during these surveys.

The Hine's emerald associate *Amphiagrion saucium* was present near the central seeps. One *Somatochlora,* likely the Hine's emerald associate *S. walshii* based on size, was seen patrolling distant cattails but departed when approached.

The roads passing the site were checked in the evening for feeding swarms, but only one large distant dragonfly, probably an *Aeshna*, was seen.

July 19. 0900-1230. 80 degrees, mostly clear becoming mostly cloudy. *Amphiagrion* were still present near the seeps. One *Libellula pulchella* was seen, as were several *Sympetrum* adults and larvae (captured by dip net and released). Burrows were present and crayfish fragments were found in the trickling streamlets shown below (Figure 35). The uncommon dragonfly *Rhionaeshna multicolor* was also found.

This should be a priority site for follow up work. .

Figure 35. Small sluggish seep fed channel harboring crayfish at County Road 4 site (previous page); above, looking southeast, an overview of the site.

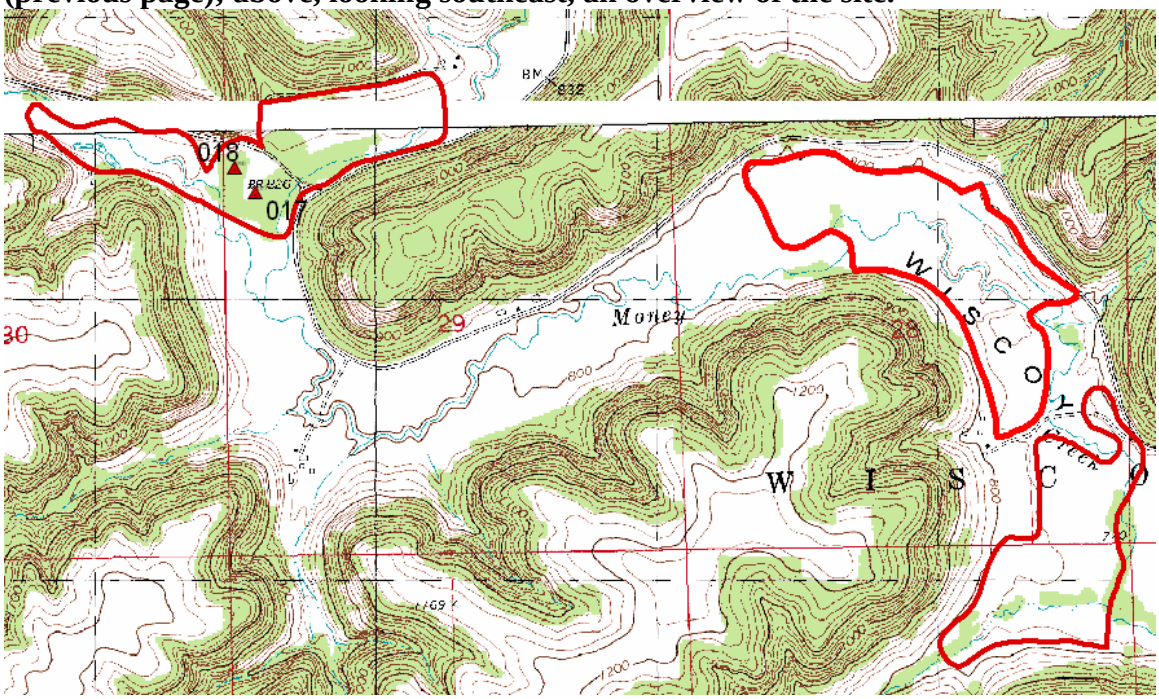

Figure 36. County Rd 4 seepage meadow site (at left). 017 is location of channels with crayfish, 018 is large seepage area. Money Creek site at right (south half of Section 28).

Money Creek T105N R07W S28 SE. June 22 1830-1930. 80 degrees, scattered clouds <20%. The habitat was evaluated at this private wetland, also a northern wet meadow/carr, sedge meadow subtype (Figure 36). The owner reports seeps are present and this appears likely, but none were found in the portion that was evaluated, north of the private driveway that bisects two sedge/seepage meadows. Although it may have some potential, it appeared to be somewhat lower quality than nearby sites. *Carex stricta* surrounds a core of tall *Typha*. The area south of his driveway is similar habitat, but has perhaps been impacted more by drainage tiles in the past. That south unit was not walked.

There appears to be potential for sedge/seepage meadows all through the Money Creek Valley connecting this and the Co. Rd. 4 site. There is also a small seep or spring fed tributary of Money Creek (SW corner of Figure 36). This is all privately owned and permission to access that private property was denied. Much of that property is in the Conservation Reserve Program.

Highway 76 seepage meadows. T105N R07 S26. July 18, cloudy and windy. 1300-1400. This site is privately owned. The site was first evaluated in poor survey conditions. This is a large seepage meadow. Seepage comes from the slopes to the east. Vegetation is similar to other seepage meadows and calcareous fens with cattails, tussock sedge, jewelweed, water dock, Joe-pye weed, arrowhead, bur reed, mint. Parts are used for pasturing cattle. The western part (near 016, Figure 39) is lower quality, but it does have the basic hydrological requirements for *hineana*. One *Anax* was flushed Habitat quality improves to the east.

Moving further east the substrate becomes wetter. A small trickle (1' x 2-4") works its way through cattails, lake sedge, and wire sedges. The water is filmy and appears stagnant, but flow continues under a stagnant surface film.

July 20. 1150-1350, partly cloudy (~30-35%) 79 degrees. Surveys began at the east end of this property, and continued onto the Highway 76 E site, to the northeast. Cattails, lake sedge, tussock sedge, mint, & blue vervain are found here. *Anax junius* and *Sympetrum semicinctum* were present. One transient *Somatochlora* was seen for a split second, but so briefly that even a definite size determination couldn't be made. No burrows were found but conditions look good for crayfish. Some pasturing is done here too.

Highway 76 NE seepage meadow T105N R07 S25NW. July 20, 1150-1350 partly cloudy (~30-35%) 79 degrees. Crayfish burrows were found, and *S. walshi* were seen several times. This area at the east end of the seepage meadows has very good seepage from the bluff above. The adjacent private land to the east is heavily used by cattle, and the seepage meadows peter out there. This site is definitely worth looking at again, as are all the sites in this part of Winona County. It is only about 70 miles from here to the closest Wisconsin *hineana* site. It is privately owned.

Figure 37. View from Highway 76 looking NE across a sea of *Typha* and sedges, toward Point 020 and seepage area at base of the distant hill.

Figure 38. Highway 76 seepage meadows

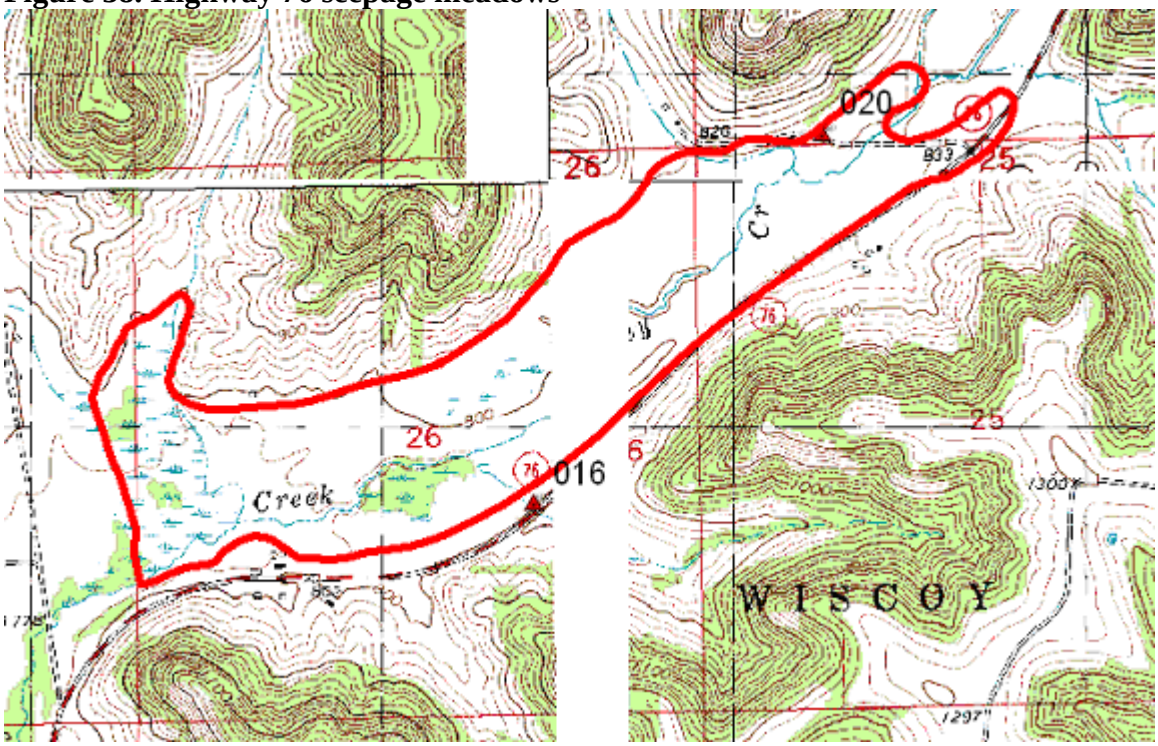

Figure 39. Highway 76 SW/ Highway 76 NE seepage meadows. Seepage flows NW at 016, through an old drainage canal or ditch. Heavy seepage and *S. walshii* at 020.

Lamoille seepage meadow and adjacent wetlands. T106 R05 S7 SE. June 23. Clear, 75+ degrees. 0900-1600. This site is part of the Upper Mississippi River NFWR and is classified a southern seepage meadow/carr. Adjacent to Highway 61 it consists almost exclusively of bur-reed (*Sparganium*). Reed canary grass is common on slightly higher ground, and arrowhead (*Sagittaria*) and Joe-pye weed are present. Although the water is only calf deep, there is a deep, soft muck layer making it very difficult and slow walking. Water trickles almost imperceptibly through the bur-reed and eventually trickles into Trout Creek (Figures 40-42). Two crayfish burrows were seen in July near the point it empties into the creek, when the water level was much lower. The source of the flowing water was not located-the bur-reed lies in an abandoned creek meander. It may originate in springs and seeps further upstream on private property.

At 1045, one medium to large teneral *Somatochlora* was seen patrolling at a distance over the bur-reed near the point where the trickles empty into the Trout Creek. Due to the deep muck, it took quite some time and a circuitous detour route to get close to where it had been, and by then it was gone. By 1300 hours one medium and one large probable *Somatochlora* were observed feeding at tree top level, far out of reach. They had more the general appearance of *S. williamsoni* than *S. hineana*, but a definite determination could not be made. They were not seen again after 1545. *Rhionaeschna multicolor*, *Libellula pulchella, Tramea lacerata* and *T. onusta* were also seen.

July 17. 0900-1200, 1400-1615. 90 degrees, clear. The *Sparganium* area near 61 had dried up considerably but is still wet and mucky. A very slight trickle of water can still be detected trickling through the reeds. Crayfish burrows were seen where the main streamlet trickles into Trout Creek just upstream from the HWY 61 bridge (Figure 42).

At 1100, a larger *Somatochlora* was seen feeding high, out of net range. *Anax junius, Libellula pulchella, Erythemis simplicollis, Aeshna* and *Sympetrum* were also observed.

July 18 1700-1930. Clear, 80 degrees. *Sympetrum semicinctum* was seen in the wetland. *Anax junius* and other dragonflies were feeding well above the drier portions of the wetland. At 1800, a single *Somatochlora* appeared and fed for 2-3 minutes. While it appeared large enough to be *S. hineana*, the abdomen appeared a bit too slender. At 1915 two larger Somatochlora fed for a few moments above Highway 61, again well out of reach. These were tantalizing sightings but a positive ID was not possible.

July 20. 1000-1130. A late start due to fog. 77 degrees, light wind, 35% cloudy. More crayfish burrows were found some distance back from the road in a different part of the wetland than before, in an area of *Sagittaria* (019, Figure 42). Once again, as always, a single large *Somatochlora* fed just too high for the net, even with a handle extension (015, Figure 42). This time I could be certain from the straight abdomen that at least it was not a male *hineana* though I could not rule out a female or *S. williamsoni*. This site should be on any list for additional surveys.

Figure 40. Sluggish, flowing channel through *Sparganium* at Lamoille

Figure 41. Lamoille near "014" on map, showing *Sparganium* (dark green) where flowage empties into Trout Creek.

Figure 42. Lamoille Seepage Meadow. Crayfish burrows at 014, 019

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Appendix

Hine's emerald associates in nearby states, from USFWS (2001)

Table 3. Odonates indicative of Hine's emerald dragonfly habitat. The listed odonate species are indicative of areas where *S. hineana* may be found. These species can aid in identifying suitable *S. hineana* habitat. This table is not a complete list of odonate species associated with *S. hineana*.

	Illinois	Wisconsin	Michigan
ANISOPTERA - DRAGONFLIES			
Aeshnidae - Darners			
Aeshna canadensis		X	X
Aeshna constricta	X		
Aeshna sitchensis			X
Aeshna umbrosa	X	X	X
Aeshna verticalis			X
Corduliidae - Green-eyed Skimmers			
Epitheca (Tetragoneuria) canis		X	
Somatochlora forcipata			X
Somatochlora incurvata			X
Somatochlora kennedyi			X
Somatochlora walshii		X	X
Somatochlora williamsoni		X	X
Libellulidae - Common Skimmers			
Leucorrhinia hudsonica			X
Leucorrhinia proxima			X
Libellula semifasciata	X		
Nannothemis bella			X
Sympetrum costiferum		X	X
Sympetrum danae		X	X
Sympetrum rubicundulum	X	X	
Sympetrum semicinctum	X	X	
ZYGOPTERA - DAMSELFLIES			
Lestidae - Spreadwing Damselflies			
Lestes dryas	X	X	X
Lestes forcipatus	X		X
Lestes unguiculatus	X		
Coenagrionidae - Narrow-winged Damselflies			
Amphiagrion saucium	X		X
Chromagrion conditum		X	